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CompTIA Project+ Cert Guide

Robin Abernathy

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CompTIA Project+ Cert Guide

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About the Author

Robin M. Abernathy has been working in the IT certification preparation industry at Kaplan IT Training, the owners of the Transcender brand, for more than 15 years. She has written and edited certification preparation materials for many (ISC)2, Microsoft, CompTIA, PMI, Cisco, EC-Council, and ITIL certifications and holds multiple IT certifications from these vendors.

Robin provides training on computer hardware and software, networking, security, and project management. She has served as technical editor for several publications and coauthored Pearson's *CompTIA Advanced Security Practitioner (CASP) CAS-002 Cert Guide* and *CISSP Cert Guide*, Second Edition. She also gives presentations at technical conferences and hosts webinars on IT certification topics.

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Dedication

For my husband, Michael, and my son, Jonas. I love you both!

Acknowledgments

First, I once again thank my Heavenly Father for knowing what I was meant to do, even when in my early adult years I said, "I will never work on computers or write for a living." God always has a plan. And I *know* He has a sense of humor!

My life would not have been complete without my surrogate brothers. While you entered my world through tragic circumstances, you have come to be my real brothers. Doug Carey and John Carey, thanks for introducing me to all things Cincinnati Reds, Batman, *Star Trek*, and Elvis. Thanks for adopting two little sisters, which I know as teenagers must have been trying at times. Love you both! Lynne and Lorrie, we love having you in our family as well! Will Carey, Bobby Carey, Christian Carey, and Jacob Carey, you have fine fathers, and I love watching as you become so much like them!

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Thanks to all at Pearson for once again assembling a wonderful team to help me get through this Project+ journey. Robin Drake and Ann Lang, I honestly think this was the best team yet. You two are rock stars!

To you, the reader, I wish you success in your IT certification goals!

—Robin Abernathy

About the Technical Reviewer

Ann Lang is a certified project manager and technical writer. She has been a technical editor for Kaplan IT Test Prep's line of IT certification products for 10 years. Prior to working as a technical writer, she worked in public broadcasting, for a university press, and in various jobs related to her lifelong love of language.

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Learn more about what the exam covers by reviewing the following:

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Learn more: **Certification.CompTIA.org/projectplus**

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Introduction

The Project+ certification is an excellent entry-level project management certification. As a globally recognized credential, the Project+ certification demonstrates that the holder has knowledge and skills across a broad range of project management topics.

Every day, in every industry, organizations large and small launch new projects. Many of these organizations realize that personnel with skills and knowledge in project management are vital to successful projects. Project+ certified professionals have more than just basic project management knowledge; to pass the Project+ exam, certification candidates must understand all aspects of project management.

Project management knowledge and skills apply to all types of projects, from construction to software development to manufacturing and all other fields. Earning Project+ certification demonstrates the project management professional's ability to initiate, plan, execute, monitor and control, complete, and close projects.

Goals of the Project+ Certification

The Project+ certification is created and managed by the Computing Technology Industry Association (CompTIA), a well-known certification body. CompTIA Project+ certification has a number of stated goals. Although not crucial for passing the exam, having knowledge of the CompTIA organization and its goals for the Project+ certification can be helpful in understanding the motivation behind the creation and contents of the exam.

Sponsoring Body

CompTIA is a nonprofit trade association that provides a vendor-neutral certification process and works with partners to create educational materials. The Project+ certification is one of a number of certifications offered by CompTIA:

- A+
- Network+
- Security+
- Linux+
- Cloud+
- Mobility+
- Server+
- CDIA+

CompTIA also offers two master-level security certifications:

- CompTIA Advanced Security Practitioner (CASP)
- Cybersecurity Analyst+ (CSA+)

Stated Goals

The goal of CompTIA in its administration of the Project+ certification is to provide a reliable instrument to measure an individual's knowledge and skills for managing the project life cycle, ensuring appropriate communication, managing resources and stakeholders, and maintaining project documentation. The topics covered in the exam are technically more shallow than those tested by some other project management certifications.

The topics that comprise the four domains of knowledge covered by the Project+ exam (PK0-004) are discussed later in this Introduction.

Value of the Project+ Certification

The Project+ certification holds value for both the exam candidate and the organization. Project management is a job skill that is increasing in popularity on job sites. Project+ is often seen as a great entry-level certification for people who are new to the project management field.

To the Project Professional

Many reasons exist for a project management professional to spend the time and effort required to achieve Project+ certification:

- To meet growing demand for project management professionals
- To become more marketable in an increasingly competitive job market
- To enhance skills in a current job
- To qualify for or compete more successfully for a promotion
- To increase earnings

In short, this credential demonstrates that the holder not only has the knowledge and skills tested on the exam but also the wherewithal to plan and implement a course of study that addresses a broad range of project management topics.

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To the Organization

For an organization, the Project+ certification offers a reliable benchmark against which job candidates can be measured by validating both knowledge and experience. Individuals holding this certification stand out, making the hiring process easier and adding a level of confidence in the final selection.

Project+ Objectives

The material contained in the Project+ exam (PK0-004) is divided into four domains, with several objectives in each:

- Project basics domain
- Project constraints domain
- Communication and change management domain
- Project tools and documentation domain

For the most part, this book devotes a chapter to each of these objectives. A few objectives have been combined logically into one chapter. Some overlap is inevitable between the domains and objectives, leading to some overlap between topics covered in the chapters. This section describes the domains and topics covered.

Project Basics Domain

The *project basics domain* covers a broad spectrum of general project management topics:

- Properties of a project
- Project roles and responsibilities
- Project phases
- Project cost control
- Project team organizational structures
- Project schedules
- Agile methodology
- Human resource, physical resource, and personnel management

Project Constraints Domain

The *project constraints domain* covers a broad range of project limiting factors:

- Project constraint variables and influences
- Project risk strategies and activities

Communication and Change Management Domain

The *communication and change management domain* covers the who, what, why, and when of communication and the change management process:

- Project communication methods
- Project communication influences
- Project communication triggers, audience, and rationale
- Project change control process and types of changes
- Organizational change

Project Tools and Documentation Domain

The *project tools and documentation domain* covers all the tools and documents that are used to manage a project successfully:

- Project management tools
- Project-centric documents
- Vendor-centric documents

Steps to Becoming CompTIA Project+ Certified

To become CompTIA Project+ certified, the candidate must meet certain prerequisites and follow certain procedures. This section covers those topics.

About the Project+ Exam

The Project+ exam is a computer-based test that the candidate can spend up to 90 minutes completing. There are no formal breaks, but you are allowed to take short breaks. Any time used for breaks counts toward the maximum cumulative time of 135 minutes, whether you take the test online or in person at a Pearson VUE authorized testing center. You must bring a government-issued identification card. No other forms of ID are accepted.

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The test will have up to 100 multiple-choice questions and drag-and-drop questions. The passing grade is 710 out of a possible 900. Candidates will receive the results at the test center from the test administrator.

Qualifying for the Exam

While there are no experience requirements for taking the exam, CompTIA recommends at least 12 months of cumulative project management experience. Because this is not a requirement, candidates can sign up for the exam without this experience, but should spend adequate study time to ensure that they have the knowledge needed for this exam.

Signing Up for the Exam

CompTIA exams are offered at Pearson VUE testing centers around the world. Certain qualified students or other individuals in the U.S. and Canada may be eligible to take the Project+ exam remotely through ProctorU instead of visiting a testing center. If you want to take the exam online, review the requirements and follow the instructions at http://proctoru.com/portal/comptia.

The steps to sign up for the Project+ exam at your local Pearson VUE testing center are as follows:

1. Create a Pearson VUE account (www.pearsonvue.com/comptia).
2. Schedule your exam at your nearest Pearson VUE facility.
3. Save your exam appointment confirmation.

After you complete the exam, you will be given a score report. Save this score report until you confirm that you have been awarded the credential by logging into https://www.certmetrics.com/comptia/login.aspx.

How To Use This Book

The goal of this book is simple: Helping you to pass the 2017 version of the CompTIA Project+ Certification exam (PK0-004).

The Project+ exam stresses a complete understanding of the knowledge areas and experience of project management. Whether you have an extensive background as a project manager in multiple industries, or you are entering the project management field for the first time, this book is designed to help you understand and master the required objectives for the exam.

This book uses several methodologies to help you 1) discover the exam topics on which you need more review, 2) fully understand and remember details about those topics, and 3) prove to yourself that you have retained your knowledge of those topics. To pass the exam, memorizing terminology is not sufficient; you must understand the concepts covered in the exam and this book.

Each chapter is structured in the following way:

- **Objectives:** The chapter opens with a list of Project+ exam topics covered in the chapter, a brief introduction to those topics, and a list of the corresponding CompTIA Project+ objectives.
- **"Do I Know This Already?" Quiz:** This quiz tests your knowledge and understanding of the main topics covered in the chapter. Detailed answers are in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions." The quiz helps you to assess whether you should read the entire chapter, read only the sections on unfamiliar topics, or jump immediately to the "Exam Preparation Tasks" section.
- **Foundation Topics:** This section holds the core content of the chapter. It explores the chapter topics with both theory and examples. In-depth descriptions, lists, tables, and figures are geared to build your knowledge so that you can pass the Project+ exam.
- **Examples:** This book presents more than 125 true-to-life examples that demonstrate how project management actually *works* in the phases, tasks, documents, processes, etc. that are part of the project manager's job. These examples are designed to give you real-world insight that is particularly useful in scenario-based questions on the live Project+ exam.
- **Key Topics:** The Key Topic icon in the margin indicates important information that you should know for the exam. Although the contents of the entire chapter could be on the exam, you should definitely know the information listed in each key topic. All of the key topics for the chapter are gathered in a Key Topics table at the end of the chapter for quick reference to the text covering each key topic.
- **Exam Preparation Tasks:** This section of the chapter moves from active learning to active exam preparation. Now that you have grasped the chapter contents, use the activities in this section to test your understanding of the information in the chapter:
  - **Review All Key Topics:** The Key Topics table in this section provides a brief summary of each chapter element marked with the Key Topic symbol described earlier. Review the contents of this table carefully to check your understanding of that topic. In case you need to refresh your

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memory or learn more, the table lists the corresponding page number where each topic begins, so you can jump instantly to that point in the chapter.

- **Define Key Terms:** This section lists all the important terms discussed in the chapter. You are expected to be familiar with these key terms for the Project+ exam. Provide your own definitions for the terms in the list, and then compare your definitions against those in the Glossary at the end of the book. The Glossary combines all the key terms from all the chapters, listed alphabetically to make each term easy to find.
- **Review Questions:** Each chapter ends with 10 multiple-choice questions, designed to test your knowledge of the chapter content. Check your selections against the answers and descriptions in Appendix A.

Who Should Read This Book?

The CompTIA Project+ examination is designed for project management in any field. The exam certifies that the successful candidate has the requisite knowledge and skills to manage projects for any type of organization.

As mentioned earlier, no project management experience is required for taking the exam. However, CompTIA recommends at least 12 months of cumulative project management experience.

This book is intended for the wide range of Project+ certification candidates, from people who seek entry-level project management know-how all the way up to experienced project managers who want to keep skills sharp, increase income, improve organizational ranking or title, or meet their organization's policies mandating certification.

Strategies for Exam Preparation

How you use this book to prepare for the exam will vary depending on your existing skills and knowledge. The ideal exam preparation would consist of years of active project management experience followed by rigorous study of the exam objectives, but that may not be practical in your case. The best way to determine your readiness for the Project+ exam is to work through the "Do I Know This Already?" Quiz at the beginning of each chapter and review the foundation topics and key topics presented in each chapter. If possible, work your way through the entire book until you can complete each subject without having to do any research or look up any answers.

If you need to study particular areas in the PK0-004 certification exam outline, find those sections in the book and review them carefully. Table I-1 lists the objectives in the Project+ exam and where those objectives are covered in this book.

Table I-1 CompTIA Project+ PK0-004 Exam Topics Mapped to Chapters

Project+ Objective	Description	Chapter
1.1	Summarize the properties of a project.	1
1.2	Classify project roles and responsibilities.	2
1.3	Compare and contrast standard project phases.	1
1.4	Identify the basics of project cost control.	3
1.5	Identify common project team organizational structures.	2
1.6	Given a scenario, execute and develop project schedules.	4
1.7	Identify the basic aspects of the Agile methodology.	6
1.8	Explain the importance of human resource, physical resource, and personnel management.	5
2.1	Given a scenario, predict the impact of various constraint variables and influences throughout the project.	7
2.2	Explain the importance of risk strategies and activities.	8
3.1	Given a scenario, use the appropriate communication method.	9
3.2	Compare and contrast factors influencing communication methods.	9
3.3	Explain common communication triggers and determine the target audience and rationale.	10
3.4	Given a scenario, use the following change control process within the context of a project.	11
3.5	Recognize types of organizational change.	11
4.1	Compare and contrast various project management tools.	12
4.2	Given a scenario, analyze project centric documentation.	13
4.3	Identify common partner or vendor-centric documents and their purpose.	14

When you feel confident in your skills, work through the "Exam Preparation Tasks" section of each chapter, and then attempt the practice exams in the Pearson Test Prep practice test software online. As you work through a practice exam, note the areas where you lack knowledge or confidence, and then review those concepts in the book. After you have reviewed those areas, work through the practice exam a second time and rate your skills. Keep in mind that the more you work through a practice exam, the more familiar the questions will be.

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After you have worked through the practice exams successfully, schedule your CompTIA Project+ PK0-004 exam as described earlier. Typically candidates should take the exam within a week of when they feel ready for the exam.

Companion Website

Register this book to get access to the Pearson Test Prep practice test software and other study materials plus additional bonus content. Check the site regularly for new and updated postings written by the author that provide further insight into the more troublesome topics on the exam. Be sure to check the box that you would like to hear from us to receive updates and exclusive discounts on future editions of this product or related products.

To access this book's companion website, follow these steps:

1. Go to www.pearsonITcertification.com/register and log in or create a new account.
2. On your Account page, tap or click the **Registered Products** tab, and then tap or click the **Register Another Product** link.
3. Enter this book's ISBN (9780789758835).
4. Answer the challenge question as proof of book ownership.
5. Tap or click the **Access Bonus Content** link for this book to go to the page where your downloadable content is available.

NOTE Keep in mind that companion content files can be very large, especially image and video files.

If you are unable to locate the files for this title by following these steps, please visit www.pearsonitcertification.com/about/contact_us, select the **Site Problems/ Comments** option, enter the requested information, and tap or click **Submit**. Pearson's customer service representatives will assist you.

NOTE The cardboard sleeve in the back of this book includes a paper that lists the activation code for the practice exams associated with this book. *Do not lose the activation code!* The paper also includes a unique, one-time-use coupon code for discounted purchase of the digital-only *CompTIA Project+ Cert Guide Premium Edition eBook and Practice Test*, with additional practice exams. (See the later section "Premium Edition" for details.)

Pearson Test Prep Practice Test Software

In addition to the bonus content on the book's companion website, this book comes complete with the Pearson Test Prep practice test software. The practice tests are available to you either online or as an offline Windows application. To access the practice exams that were developed with this book, you will need the unique activation code printed on the paper in the cardboard sleeve in the back of this book.

Accessing the Pearson Test Prep Software Online

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1. Go to http://www.PearsonTestPrep.com.
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3. Enter your email/password for your account. If you don't have an account on PearsonITCertification.com, you will need to establish one by going to PearsonITCertification.com/join.
4. In the **My Products** tab, click the **Activate New Product** button.
5. Enter the access code printed on the insert card in the back of your book to activate your product.
6. The product will now be listed in your My Products page. Click the **Exams** button to launch the exam settings screen and start your exam.

Accessing the Pearson Test Prep Software Offline

If you want to study offline, you can download and install the Windows version of the Pearson Test Prep practice test software. There is a download link for this software on the book's companion website, or you can enter this link in your browser:

http://www.pearsonitcertification.com/content/downloads/pcpt/engine.zip

To access the book's companion website and the software, follow these steps:

1. Register your book by going to PearsonITCertification.com/register and entering the ISBN: **9780789758835**.
2. Respond to the challenge questions.
3. Go to your account page and select the **Registered Products** tab.
4. Click the **Access Bonus Content** link under the product listing.

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5. Click the **Install Pearson Test Prep Desktop Version** link under the Practice Exams section of the page to download the software.
6. After the software finishes downloading, unzip all the files on your computer.
7. Double-click the application file to start the installation, and follow the onscreen instructions to complete the registration.
8. After the installation is complete, launch the application and select the **Activate Exam** button on the My Products tab.
9. Click the **Activate a Product** button in the Activate Product Wizard.
10. Enter the unique access code found on the card in the sleeve in the back of your book, and click the **Activate** button.
11. Click **Next** and then the **Finish** button to download the exam data to your application.
12. You can now start using the practice exams by selecting the product and clicking the **Open Exam** button to open the exam settings screen.

Note that the offline and online versions will sync together, so saved exams and grade results recorded on one version will be available to you on the other as well.

Premium Edition

In addition to the free practice exams provided with your purchase, you can purchase expanded exam functionality from Pearson IT Certification. The digital-only *CompTIA Project+ Cert Guide Premium Edition eBook and Practice Test* contains additional practice exams as well as the eBook (in PDF, ePub, and MOBI/Kindle formats). In addition, the Premium Edition title links each question to the specific part of the eBook related to that question.

If you purchased the print version of this title, you can purchase the Premium Edition at a deep discount. The cardboard sleeve in the back of this book contains a paper with a one-time-use coupon code and instructions for purchasing the Premium Edition.



This chapter covers the following topics:

- **Understand the definition of a project:** Project properties including temporary, start and finish, unique, and reason/purpose.
- **Understand a project as part of the program:** How projects fit into an organization's overall program.
- **Understand a project as part of the portfolio:** How projects fit into an organization's overall portfolio.
- **Compare and contrast standard project phases:** Initiating phase, Planning phase, Executing phase, Monitoring and Controlling phase, and Closing phase.

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Project Properties and Phases

Every industry has projects. Contractors build buildings. IT companies launch new services. Hospitals revise processes to conform with new standards or regulations. Retail businesses launch new mobile apps for their customers. All of these activities are projects, even if the organization does not expressly call them "projects" or complete the formal project management phases.

A project is temporary in that it has a defined beginning and end, scope, budget, and resources. If all of these parameters are not defined at the beginning of the project, you have no way of measuring the success or failure of the project. For this reason, all types of organizations should employ professionals with project management knowledge.

Project management knowledge involves understanding the properties of all projects, understanding projects as part of an organization's overall program and portfolio, and understanding the phases and knowledge areas of all projects.

This chapter covers the following objectives for the CompTIA Project+ exam:

1.1 Summarize the properties of a project.

1.3 Compare and contrast standard project phases.

NOTE This book follows most project management standards in naming the five project phases *Initiating*, *Planning*, *Executing*, *Monitoring and Controlling*, and *Closing*. Some organizations—including CompTIA—might use slightly different wording (*Initiation*, *Close*, and so on), but the phases are the same. Watch for variations of the phase names on the Project+ exam, to avoid being tripped up by terminology. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own

assessment of your knowledge of the topics, read the entire chapter. Table 1-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 1-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section(s)	Questions Covered in This Section
Definition of a Project	1
Project as Part of a Program *and* Project as Part of a Portfolio	2
Project Phases	3–7
Project Knowledge Areas	8–10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which of the following is *not* a quality of a project?
   - **a.** start and finish
   - **b.** permanent
   - **c.** unique
   - **d.** reason

2. Which of the following statements regarding programs and portfolios is true?
   - **a.** All projects are part of the portfolio.
   - **b.** Only certain programs are part of the portfolio.
   - **c.** Each project must be part of a program.
   - **d.** Each program within a project is managed in a coordinated method.

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3. During which project phase is the project charter created?
   a. Planning
   b. Executing
   c. Initiating
   d. Monitoring and Controlling

4. Which of the following occurs or is created during the Planning phase?
   a. business case
   b. deliverables
   c. change control
   d. work breakdown structure

5. During which project phase are project deliverables created?
   a. Executing
   b. Planning
   c. Initiating
   d. Monitoring and Controlling

6. Which of the following occurs or is created during the Monitoring and Controlling phase?
   a. requirements
   b. schedule
   c. quality assurance
   d. budget

7. During which project phase does change control occur?
   a. Planning
   b. Initiating
   c. Executing
   d. Monitoring and Controlling

8. Which project knowledge area is primarily concerned with managing the project team?
   a. Communication management
   b. Human resource management
   c. Scope management
   d. Integration

9. In which knowledge area are threats to the project identified?
   a. Scope management
   b. Quality management
   c. Risk management
   d. Procurement management

10. Which project documentation is created as part of cost management?
   a. schedule
   b. budget
   c. work breakdown structure
   d. requirements

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Foundation Topics

Key Topic

Definition of a Project

The Project Management Institute (PMI) defines a *project* as "a temporary endeavor undertaken to create a unique product, service, or result." A project is based on the needs of the project sponsor or customer and may be terminated by the same entity. Every project creates a unique product, service, or result. Once the project is complete, the project's product, service, or result may continue to affect society, the economy, the sponsor, and the environment.

Projects are undertaken at all levels and in all departments of an organization. No matter which levels or departments are involved, the project team will be responsible for completing the project within budget and on schedule.

EXAMPLE: Upper management has a project to analyze the organization for Lean practices. The human resources department has a project to deploy a new employment application. All departments are involved in a project to redesign the network infrastructure, with the IT department heading the project.

Projects happen all around us every day and involve every industry. To ensure project success, organizations should employ personnel who understand project management and grasp the difference between *projects* and *day-to-day operations*. To fully comprehend the distinction, compare the examples in the two columns in Table 1-2.

Table 1-2 Projects Versus Day-to-Day Operations

Project	Day-to-Day Operation
Launching a new web server	Upgrading a web server's operating system
Developing processes for backing up a file server	Backing up the file server according to established processes and procedures
Documenting the help desk process	Performing daily tasks at the help desk
Constructing a new facility	Maintaining a facility
Launching a new jewelry line in a retail chain	Adding new inventory to a current jewelry line
Upgrading a fleet of automobiles to include video recorders	Performing routine maintenance (such as oil changes) on a fleet of automobiles
Designing a training program for teachers' aides	Training teachers' aides on new school system policies

Projects may produce tangible and/or intangible outcomes. *Tangible* outcomes are physical assets that can be measured, such as land, vehicles, equipment, machinery, furniture, inventory, and cash. *Intangible* outcomes are nonphysical assets such as patents, trademarks, franchises, good will, and copyrights.

All projects are temporary, have a defined start and finish, have a unique outcome, and have a reason or purpose. The following sections describe these project characteristics.

Temporary

The temporary nature of projects indicates that a project is undertaken for a set time period and will finish at some point. Being temporary has nothing to do with the length of the project—just that it has initiation and completion dates. The result of the project is not necessarily temporary—only the project itself. In fact, most projects result in a lasting outcome. Outcomes from the projects in Table 1-2 include a web server, a backup process and procedure, a help desk process, a new building, a new jewelry line, video recorders in a fleet of automobiles, and a training program. So while the project is temporary, the result is permanent and will usually affect the project sponsor or customer until the result is no longer needed or no longer meets the sponsor's or customer's needs.

Start and Finish

Defined start and finish dates for a project are critical. Without defined start and finish dates, a project is not constrained by time and can become part of the day-to-day operations. Defining start and finish dates helps personnel to ensure that the project is completed. Project management professionals must be able to analyze the scope of the project to determine the amount of time needed to complete the project. To complete a project within a set time limit, you may also need to trim back other aspects of the project, such as its scope or budget. Setting the start and finish dates should be completed during the early phases of the project.

Unique

The result of the project should be unique. Although some projects may contain repetitive elements, each project remains unique, with different design, location, circumstance, stakeholders, or other elements.

EXAMPLE: A construction company builds many types of buildings. Most of the buildings have the same elements, such as the foundation, framing, plumbing, electrical, and so on. However, no two buildings are exactly alike. Even if two buildings

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follow the same building plan, the buildings will not be built in exactly the same location with exactly the same team members and supplies.

Reason/Purpose

The project's reason or purpose should be stated clearly to ensure that the project sponsor and all other stakeholders understand it. Projects should provide business value to the sponsoring organization. Value may be created by a new physical asset or process. It can even be created through effective redesign of ongoing operations. But the project must have a reason or purpose to ensure that this business value is provided.



Project as Part of a Program

A *program* is a grouping of related projects or activities that are managed in coordination to obtain benefits not available if they were managed individually. The projects within a program are related because they have a common outcome.

EXAMPLE: An organization's program includes several projects that involve the renovation of multiple facilities. Each facility renovation or each facet of renovation (plumbing, electrical, and so on) is a project, with all the projects together comprising the program.

TIP A project does not have to be part of a program, but a program always includes projects.

Because the primary benefit from a program is coordination, a program should be used to ensure that each project's resources, conflicts, goals, objectives, and changes are managed from a program perspective. Projects within a program must focus on the interdependence between the projects.

TIP If projects do not share an outcome but are related through a shared client, seller, technology, or resource, they are part of the same *portfolio*—not the same *program*.



Project as Part of a Portfolio

A *portfolio* includes all of the projects, programs, and operations managed by an organization to allow it to reach strategic objectives. The projects and programs included in a portfolio do not necessarily depend on each other.

To fully understand the relationship between projects, programs, and the portfolio, keep these points in mind:

- All projects are part of the portfolio.
- All programs are part of the portfolio.
- Each project may be part of a program or be independent.
- Each project within a program is managed in a coordinated method.
- All projects and programs within the portfolio are linked to the organization's strategic plan.

Key Topic

Project Phases

Each project is divided into five project *phases* (sometimes referred to as *process groups*):

1. Initiating phase
2. Planning phase
3. Executing phase
4. Monitoring and Controlling phase
5. Closing phase

Project managers ensure that the organization includes all of these phases as part of project management. Although these phases are often listed in a linear manner, they are not necessarily performed in a straight linear fashion. For example, after creating a few of the deliverables as part of the Executing phase and monitoring the result as part of the Monitoring and Controlling phase, it may be necessary to review and modify the plans that were created as part of the Planning phase. Figure 1-1 shows an example of the project management phases.

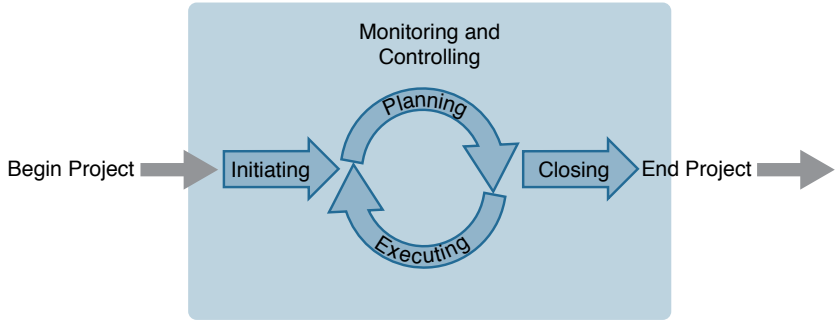


Figure 1-1 Project Management Phases

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Each phase within the project management life cycle includes processes that cover the actions and activities performed to complete the project. Each process falls into one of the five project phases. Project managers must understand these processes, the phases in which they operate, and the interrelationships between the processes.

NOTE The project roles mentioned in this chapter are discussed in detail in Chapter 2, "Project Roles, Responsibilities, and Team Structures."

Key Topic

Initiating Phase

The Initiating phase defines a new project and obtains authorization to start the project. During this phase, the organization selects a project manager, and the project manager defines the initial scope, financial resources, and stakeholders. The key purpose of this phase is to align stakeholder expectations with the project's scope and objectives.

In the Initiating phase, the project manager develops the project charter and identifies the stakeholders. This phase includes creating the following project documentation:

- Project charter
- Business case
- High-level scope definition
- High-level risks
- Stakeholder register

The following sections briefly describe these documents.

Project Charter

The project charter authorizes the project and allows the project manager to apply organizational resources to complete the project. The charter is formally issued by the project sponsor. The project's statement of work, business case, procurement agreements, and other organizational assets and factors provide input to the project charter. It includes the project's purpose, objectives, requirements, assumptions and constraints, high-level scope and risks, summary milestone schedule, summary budget, and stakeholder list. The project sponsor must formally authorize the project based on the project charter.

An *assumption* is a factor in the Planning phase that is considered to be true, and a *constraint* is a limiting factor that affects the execution of the project. For example:

- **Assumption:** A typical deliverable for the project will take approximately four weeks to complete.
- **Constraint:** A specific number of team members must be available to work on the project.

Business Case

The *business case* establishes the benefits of the project and acts as a basis for project authorization. It is used to determine whether the project is worth the investment. A business case is usually created as a result of market demands, organizational needs, customer requests, technological advances, legal requirements, ecological impacts, or social needs.

High-Level Scope Definition

The *high-level scope definition* is part of the project charter. It defines the high-level work that must be performed to deliver the project's result. Later in the Planning phase, the high-level scope definition will be expanded and eventually will include the individual work units that must be completed for the project.

High-Level Risks

The *high-level risks* are part of the project charter. The term *risk* describes any uncertain event that may have a positive or negative effect on the project's objectives. Risks are more formally defined in the Planning phase.

Stakeholder Register

The stakeholder register contains a list of all identified stakeholders and includes identification information, requirements and expectations, influence on the project, and their classification. The stakeholder register is used later to create the stakeholder management plan.



Planning Phase

The Planning phase establishes the total project scope and objectives and then develops the actions required. During this phase, the project manager defines the project's scope, schedule, budget, quality, human resource needs, communication

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methods, risks, and procurements. The key purpose of this phase is to define the actions required to complete the project successfully.

In this phase, the project manager develops the project management plan and all its subsidiary plans, including creating the following project documentation:

- Schedule
- Scope management plan
- Work breakdown structure
- Scope baseline
- Scope statement
- Resources
- Detailed risks
- Requirements
- Requirements management plan
- Communication plan
- Stakeholder management plan
- Procurement management plan
- Change management plan
- Budget

The following sections briefly describe these documents.

Schedule

The *schedule* presents project activities with the planned start/end dates, durations, milestones, and resources used. For the project to be accurate, project managers must determine the activities needed, the resources required to complete the activities, and the resource calendars regarding resource availability.

Scope Management Plan

The *scope management plan* describes how the scope is defined, developed, monitored, controlled, and verified. It is one of the main components of the project management plan.

Work Breakdown Structure (WBS)

The *work breakdown structure (WBS)* is a hierarchical listing of the activities or work packages that must be completed during the project. Each work package within the WBS should have a unique identifier to help link the work packages with their costs, schedules, and resources. The *WBS dictionary* is a companion document to the WBS and provides detailed information about each WBS component, including the identifier, description, and scheduling information.

Scope Baseline and Scope Statement

The WBS is part of the *scope baseline*, which includes the project scope statement, WBS, and WBS dictionary. The scope baseline is used as the basis for comparing scope control during the Executing phase and the Monitoring and Controlling phase. The *scope statement* includes the project scope description, major deliverables, assumptions, and constraints.

Resources

The project's *resources* include the personnel, equipment, services, supplies, and funds needed to complete the project. Each resource will need a resource calendar that defines the days and hours that the resource will be available.

Detailed Risks

The *detailed risks* are defined in the project's *risk register*. Once all the risks are identified as part of the risk management process, responses to each risk must be identified. Risks should be identified as being positive or negative. Negative risks can cause serious problems and derail the project. Positive risks are desirable opportunities. For example:

- **Negative risk:** Possibility of a rise in costs for construction materials for a construction project.
- **Positive risk:** Finishing a deliverable the week before its due date, thereby granting some slack in the project schedule.

Requirements and the Requirements Management Plan

The *requirements* of a project include any stakeholder needs and specifications for the project. Often these requirements must be negotiated using decision-making techniques. Requirements are documented during the development of the scope

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management plan and are included in the requirements management plan. The *requirements management plan* describes how requirements will be analyzed, documented, and managed.

Communication Plan

The *communication plan* describes how, when, and by whom information about the project will be distributed to the project team and stakeholders. Project managers must document the stakeholders and their preferred communication methods in this plan. The plan should also include information about project status meetings and project team meetings.

Stakeholder Management Plan

The *stakeholder management plan* identifies how to manage and engage the project stakeholders, including their engagement level, relationships, and communication requirements. The stakeholder management plan is used in conjunction with the communication plan to manage stakeholder engagement.

Procurement Management Plan

The *procurement management plan* (also called *procurement plan*) describes how any goods and services for the project will be procured from outside sources. The project manager should work with the organization to develop criteria for selecting procurement sources. Depending on the goods and services needed from third parties, a project manager may need to manage multiple suppliers and contract types.

Change Management Plan

The *change management plan* defines how project change requests will be managed and implemented. Changes can only be implemented after undergoing a formal approval process. Changes usually affect the scope, budget, and schedule of the project.

Budget

The *budget* is the cost estimate for the project. It includes a breakdown of the costs for individual WBS work packages, procurements, and any scheduled activities. Because budgets are based on cost estimates, project managers should constantly analyze actual costs and compare them to the budgeted costs.



Executing Phase

The Executing phase completes the work defined in the project management plan. During this phase, the project manager coordinates personnel and other resources and manages stakeholder expectations. The major portion of the project's budget will be expended during this phase.

In the Executing phase, the project manager directs the project work, quality assurance, and communications. In addition, the project manager develops and manages the project team as well as conducting procurements.

The main output of this phase is the project *deliverables*, which are the unique work packages defined in the WBS.



Monitoring and Controlling Phase

The Monitoring and Controlling phase tracks, reviews, and organizes the project's progress. During this phase, the project manager identifies areas where changes are required and initiates the approved changes. The key purpose of this phase is to measure and analyze project performance at regular intervals to identify variances from the project management plan.

In the Monitoring and Controlling phase, the project manager monitors and controls the project's work, scope, schedule, budget, quality, communication, risks, and procurements. This phase involves the following project documentation and activities:

- Issues log
- Performance measuring and reporting
- Quality assurance/governance
- Change control
- Budget

The following sections briefly describe these documents and activities.

Issues Log

The *issues log* records any team member or stakeholder issues that are being discussed. Issues may become formal change requests if the project sponsor approves them. Issues that might occur again can become risks if the project manager thinks that a plan for them should be formalized.

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NOTE At the time of writing, the CompTIA objectives refer to this document as the *risks/issues log*. However, this terminology is not used in project management standards. The *risk register* is created during the Planning phase, and it documents any identified risks as well as planned responses. The *issues log* is created during the Monitoring and Controlling phase, and it documents any stakeholder issues that arise. Some issues are easily handled without elevating their status to risks. Most project risks are identified in the Planning phase. Issues recorded in the issues log may or may not be added to the risk register.

EXAMPLE: During project execution, a team member needs to install a vulnerability analysis tool on several computers, but does not have administrative rights to do so. This issue is entered in the issues log. Administrative-level permissions will need to be granted to the team member or other appropriate person (such as the project manager), who can then install any tools and applications requiring such rights.

Performance Measuring and Reporting

Performance measuring and reporting compares actual project performance to the baselines defined in the project management plan. The results are used to control the project's changes, scope, schedule, costs, quality, risks, and procurements. Raw performance data is obtained and compared to the baselines, yielding detailed information about work performance. This information is then integrated into project reports.

Quality Assurance/Governance

Quality assurance/governance takes the project's quality metrics and checklists and uses tools such as fishbone diagrams, flowcharts, and histograms to resolve any quality problems. Quality control issues that are identified may require a project change to ensure that deliverable quality is maintained as set forth in the project management plan.

Change Control

Change control reviews, approves, and manages project change requests. If a change is not approved, the change request is simply entered in the change log. If a change is approved, it will be processed by the project manager or team member according to the change control process.

Budget

The project budget is updated and managed based on the actual costs that are accrued as the work is completed. Actual costs should always be compared to the baseline budget, which is the original approved budget.



Closing Phase

The Closing phase completes all project activities. During this phase, the project manager verifies that the project's defined processes are complete. The key purpose of this phase is to close the project formally. Projects are closed when all the work is complete, but they can also be closed prematurely because of project cancellation or critical situations.

In the Closing phase, the project manager closes the project and all procurements that are part of the project. This phase involves the following project documentation and activities:

- Transition/integration plan (including training)
- Project sign-off
- Archiving project documents
- Lessons learned
- Releasing resources
- Closing contracts

The following sections briefly describe these documents and activities.

Transition/Integration Plan

The *transition/integration plan* includes details on how the project team will be transitioned to or integrated into other projects or areas within the organization. Training is often provided as part of this closure to ensure that the project team obtains the skills needed for the new project or area.

Project Sign-Off

The *project sign-off* provides a formal method for validating project completion according to the project management plan. The sign-off is usually completed by the project manager and signed by the project sponsor.

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Archiving Project Documents

Project managers must *archive* all project documents to ensure that they are maintained until they are no longer needed. Laws and regulations may govern how long and in what form records must be retained. Project managers should follow set procedures to ensure that the documents are stored in a location and format from which they can be retrieved.

Lessons Learned

Lessons learned documents record any knowledge gained during the project, showing how project issues and events were addressed. Lessons learned are documented for the sole purpose of improving future project performance.

Releasing Resources

During the Closing phase, project managers should formally *release* all resources in use. For personnel, this should include completing an evaluation of the project team member's performance. For equipment, services, supplies, and funds needed to complete the project, the project manager must formally release these assets back to the project sponsor.

Closing Contracts

Finally, the project manager must close all project procurement contracts. Documenting the vendor's performance and any issues is important, in order to ensure that future project procurements will have this data to analyze.



Project Knowledge Areas

Whereas project phases describe how a project progresses through its life cycle, *project knowledge areas* describe how the project's processes are grouped into shared specialization activities. A project process will fit into both a project phase and a project knowledge area. For example, developing the project charter is part of the Initiating phase and the project integration knowledge area. Most projects have 10 main project knowledge areas:

- Project integration
- Scope management
- Time management
- Cost management

- Quality management
- Human resource management
- Communication management
- Risk management
- Procurement management
- Stakeholder management

Project managers need to understand the activities involved in each of the project knowledge areas and where in the project life cycle they should be completed. The following sections briefly describe these project knowledge areas.

Project Integration

Project integration identifies and coordinates all the processes and activities in a project. It includes developing the project charter and the project management plan, directing and managing project work, monitoring and controlling project work, performing integrated change control, and closing the project.

The project manager develops the project charter during the Initiating phase and the project management plan during the Planning phase. The project work is directed and managed during the Executing phase. Project work is monitored and controlled during the Monitoring and Controlling phase. Change control also takes place during the Monitoring and Controlling phase. Closing the project occurs during the Closing phase.

Scope Management

Project *scope management* ensures that the work required by the project is complete and falls within the defined project scope. It includes creating the *scope management plan* (which is part of the project management plan), collecting the requirements, defining the scope, creating the WBS, validating the scope, and controlling the scope.

The project manager develops the scope management plan, collects the requirements, defines the scope, and creates the WBS during the Planning phase. Validating and controlling the scope occurs during the Monitoring and Controlling phase.

Time Management

Project *time management* ensures that the project is completed on time. It includes creating the schedule management plan (which is part of the project

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management plan), defining and sequencing the activities, estimating the activity resources and durations, developing the schedule, and controlling the schedule.

The project manager develops the schedule management plan, defines and sequences the activities, estimates the activity resources and durations, and develops the schedule during the Planning phase. Controlling the schedule occurs during the Monitoring and Controlling phase.

Cost Management

Project *cost management* ensures that the project costs are completed within the approved budget. It includes creating the cost management plan (which is part of the project management plan), estimating the costs, determining the budget, and controlling costs.

The project manager develops the cost management plan, estimates the costs, and determines the budget during the Planning phase. Controlling costs occurs during the Monitoring and Controlling phase.

Quality Management

Project *quality management* ensures that the project quality satisfies the needs of the project. It includes creating the quality management plan (which is part of the project management plan), performing quality assurance, and controlling quality.

The project manager develops the quality management plan during the Planning phase. Quality assurance occurs during the Executing phase, and quality control occurs during the Monitoring and Controlling phase.

Human Resource Management

Project *human resource management* ensures that the project team is organized and managed to complete the project. It includes creating the human resource management plan (which is part of the project management plan) and acquiring, developing, and managing the project team.

The project manager develops the human resource management plan during the Planning phase. Acquiring, developing, and managing the project team occurs during the Executing phase.

Communication Management

Project *communication management* ensures that project information is properly created, distributed, and stored. It includes creating the communication plan (which

is part of the project management plan) and managing and controlling all project communications.

The project manager develops the communication plan during the Planning phase. Managing communication occurs during the Executing phase, and controlling communication occurs during the Monitoring and Controlling phase.

Risk Management

Project *risk management* ensures that project risks (also called *threats*) are identified, analyzed, and controlled. It also involves planning risk responses. This project knowledge area includes creating the risk management plan (which is part of the project management plan), identifying the risks, performing qualitative and quantitative risk analysis, planning risk responses, and controlling risks.

The project manager creates the risk management plan, identifies risks, performs qualitative and quantitative risk analysis, and plans risk responses during the Planning phase. Controlling risks occurs during the Monitoring and Controlling phase.

Procurement Management

Project *procurement management* ensures that any products or services needed from a third party are acquired. This project knowledge area includes creating the procurement management plan (which is part of the project management plan) and conducting, controlling, and closing procurements.

The project manager creates the procurement management plan during the Planning phase. Conducting procurements occurs during the Executing phase, controlling procurements occurs during the Monitoring and Controlling phase, and closing procurements occurs during the Closing phase.

Stakeholder Management

Project *stakeholder management* documents the expectations and project impact of any people, groups, or organizations that will be affected. In addition, stakeholder management strategies are developed. It includes identifying stakeholders, creating the stakeholder management plan (which is part of the project management plan), and managing and controlling stakeholder engagement.

The project manager identifies the stakeholders during the Initiating phase and creates the stakeholder management plan during the Planning phase. Managing stakeholder engagement occurs during the Executing phase, and controlling stakeholder engagement occurs during the Monitoring and Controlling phase.

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Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 1-3 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 1-3 Key Topics for Chapter 1

Key Topic Element	Description	Page Number
Section	Definition and overview of *project*	7
Section	Relationship between *project* and *program*	9
Section	Relationships between *project*, *program*, and *portfolio*	9
List; Figure 1-1; section	Definition and overview of *project phases*	10
Section	Overview of *Initiating phase*	11
Section	Overview of *Planning phase*	12
Section	Overview of *Executing phase*	16
Section	Overview of *Monitoring and Controlling phase*	16
Section	Overview of *Closing phase*	18
Section	Overview of *project knowledge areas*	19

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

project, tangible outcome, intangible outcome, program, portfolio, project phase, Initiating phase, project manager, project scope, project stakeholder, project charter, project statement of work, procurement agreement, assumption, constraint, project sponsor, business case, high-level scope, high-level risks, stakeholder register, Planning phase, project schedule, project budget, scope

management plan, work breakdown structure (WBS), scope baseline, scope statement, WBS dictionary, resources, risk, risk register, negative risk, positive risk, project requirements, requirements management plan, communication plan, stakeholder management plan, procurement management plan, change management plan, Executing phase, project management plan, project deliverable, Monitoring and Controlling phase, issues log, performance measuring and reporting, quality assurance, change control, Closing phase, transition/integration plan, project sign-off, archive, lessons learned, resource release, project knowledge area, project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communication management, project risk management, project procurement management, project stakeholder management

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. Which of the following is *not* a project?
   a. Deploying a new web server
   b. Building a new customer app
   c. Installing the latest operating system and application updates
   d. Designing a new electric engine

2. Your company currently has the following projects in progress:
   - Deploying a new file server for a single department.
   - Documenting the IT change management process.
   - Installing the flooring as part of the first floor remodeling.
   - Painting the walls as part of the first floor remodeling.
   - Purchasing new accessories and office furniture as part of the first floor remodeling.
   - Updating the antivirus and anti-malware signatures on all client and server computers.

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Which of the following statements is *not* true for these projects?

a. The three remodeling projects are part of a program.

b. The three remodeling projects are part of the project portfolio.

c. Updating the antivirus and anti-malware signatures is not a project.

d. All of the projects listed are part of the project portfolio.

3. You have completed the project charter and business case for a new project. In which phase of project management are you working?

a. Planning

b. Initiating

c. Executing

d. Closing

4. Which of the following are created during the Planning phase of a project?

a. Budget and schedule

b. High-level requirements and risks

c. Deliverables

d. Changes

5. For a project you are managing, you have documented several issues that arose after you reviewed the project deliverables. As a result, you identified a new risk. In which project phase are you engaged?

a. Executing

b. Monitoring and Controlling

c. Planning

d. Closing

6. You are documenting the lessons learned for a project that researched a new product line for your company. You release the project resources and obtain project sign-off from the project sponsor. Which project phase are you completing?

a. Initiating

b. Planning

c. Closing

d. Executing

7. In which project phase is quantitative and qualitative risk analysis performed?
   a. Planning
   b. Executing
   c. Initiating
   d. Monitoring and Controlling

8. Which of the following occur during the Executing phase of a project?
   a. performing change control and validating scope
   b. developing the project charter and identifying stakeholders
   c. estimating costs and defining scope
   d. acquiring the project team and performing quality assurance

9. Which of the following is completed as part of project time management?
   a. sequencing activities
   b. creating the work breakdown structure
   c. estimating costs
   d. identifying risks

10. During which project phase should you ensure that the project team receives the appropriate training?
    a. Planning
    b. Executing
    c. Initiating
    d. Monitoring and Controlling

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This chapter covers the following topics:

- **Understand project roles and responsibilities:** Project sponsor, project manager, project coordinator, stakeholder, schedule, project team, and project management office (PMO).
- **Understand project team structures:** Functional, matrix, and projectized team structures.

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Project Roles, Responsibilities, and Team Structures

Now that you understand that every organization has projects, what projects are, and what their basic life cycle is, it is time to learn a bit about project roles, responsibilities, and team structures. Project *roles* are the job duties that are part of a project. Each project role has a particular responsibility that personnel must complete to ensure that the project is successful. The project is further affected by the organization's structure, which will control resource availability and how the project is conducted.

This chapter covers the following objectives for the Project+ exam:

1.2 Classify project roles and responsibilities.

1.5 Identify common project team organizational structures.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 2-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 2-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Project Roles and Responsibilities	1–6
Project Team Structures	7–10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which individual or organization gives final approval for a project?
   a. sponsor
   b. project manager
   c. stakeholder
   d. PMO

2. Which of the following is *not* a responsibility of the project manager?
   a. managing the team
   b. creating the project deliverables
   c. creating the budget
   d. creating the schedule

3. Which project role supports the project manager and coordinates cross-functional tasks?
   a. stakeholder
   b. sponsor
   c. project team
   d. project coordinator

4. Which of the following is a responsibility of project stakeholders?
   a. creating the business case
   b. creating the budget
   c. providing project requirements
   d. creating project deliverables

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5. Which project role is primarily concerned with managing project time?
   a. project manager
   b. sponsor
   c. project team
   d. scheduler

6. Which of the following is *not* a responsibility of the PMO?
   a. setting project management standards
   b. providing templates
   c. estimating costs
   d. providing tools

7. Which of the following is *not* a project team structure?
   a. matrix
   b. hybrid
   c. functional
   d. projectized

8. In which project team structure do project managers hold little to no authority?
   a. weak matrix
   b. strong matrix
   c. functional
   d. projectized

9. Which of the following statements is true for a projectized team structure?
   a. resources report to the project manager
   b. authority is shared between the project manager and the functional manager
   c. authority belongs to the functional manager
   d. it ranges from weak to strong

10. In which project team structure are resources most likely to be assigned from their functional area to the project?

- **a.** matrix
- **b.** hybrid
- **c.** functional
- **d.** projectized

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Foundation Topics

Project Roles and Responsibilities

Each project includes project roles that are responsible for certain project responsibilities. Every project has a project sponsor, project manager, stakeholders, and a project team. Optional project roles may include project coordinator and scheduler. Finally, some organizations have a central project management office. This section discusses all of these roles and the responsibilities that can be involved in a project.

Key Topic

Project Sponsor

The project *sponsor*, also referred to as the project *champion*, is the individual or organization that authorizes the project. The sponsor is responsible for providing funding for the project and establishing the project charter, project baseline, and high-level requirements. Ultimate control of the project lies with the project sponsor, who is also responsible for marketing the project across the organization to ensure stakeholder buy-in. The sponsor must document all project roadblocks and work with the project manager to alleviate those roadblocks. The sponsor completes the business case/justification for the project, and the sponsor also must select or approve the project manager.

In most cases, the project sponsor must be consulted for any potential project changes. The sponsor authorizes or provides all resources, as well as canceling or formally closing the project.

The project sponsor is a mandatory role.

Key Topic

Project Manager

The *project manager* is the individual who is selected to lead the project team. The project manager is responsible for ensuring that the project is a success. Project managers should assess project needs, task needs, and team needs, using these assessments strategically to guide the project toward its goal. A project manager must have project management knowledge and experience and must know how to accomplish the project goals. Finally, he/she must have personality characteristics, interpersonal skills, and leadership skills to lead the project team effectively.

The project manager must manage the team, communication, scope, risks, budget, time, and quality assurance for the project. All project documentation and artifacts are the responsibility of the project manager.

The project manager must communicate appropriately with all project stakeholders but is ultimately accountable to the project sponsor.

The project manager is a mandatory role.

Key Topic

Project Coordinator

The *project coordinator* supports the project manager in coordinating activities, resources, equipment, and information. While the project manager is responsible for overall project success, the project coordinator focuses mainly on project implementation and cross-functional coordination of all project tasks. If the project coordinator is unable to resolve a project issue, the coordinator will escalate the issue to the project manager. Trust is vital to the relationship between a project coordinator and a project manager.

The project coordinator helps with project documentation and administrative support. Project coordinators are responsible for scheduling resources and checking the quality of deliverables.

Some organizations use project coordinators when multiple projects must share resources. This type of project coordinator helps with any issues that may arise over shared resources. No matter whether the project coordinator works on one project or multiple projects, a partnership between the project coordinator and the project manager is vital.

The project coordinator role is not mandatory, meaning that project success can be achieved without filling this role.

Key Topic

Stakeholder

A project *stakeholder* is any individual, group, or organization with a vested interest in the success of a project. The stakeholder may affect or be affected by the project's outcome. A project manager should fully analyze project stakeholders to determine their interest (level of concern), influence (active involvement), impact (ability to affect project change), urgency (need for attention), legitimacy (appropriate or inappropriate involvement), and power (level of authority) in the project.

Once stakeholders are identified, the stakeholders should provide input and requirements to the project manager. They also provide project steering and expertise.

Stakeholders should be documented along with their roles, level of knowledge, and project expectations. The project manager should determine the best communication method to use with each stakeholder. Managing stakeholder expectations is key because not every expectation will be achievable. In fact, one stakeholder's

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expectation may be directly opposite to another's. For this reason, the project manager will need interpersonal skills to negotiate with stakeholders to determine which expectations are attainable and ensure the project's success.

Scheduler

A project *scheduler* develops and maintains the project schedule, as well as working to ensure that resources are available when needed. This individual determines schedule, cost, and resource deviations through trend analysis and earned value management, thereby reporting schedule performance. The scheduler solicits task status from resources, monitors project milestones, communicates any schedule changes, and takes an active role in all project meetings. Depending on the project and organization size, this role may or may not be separate from the roles of project manager or project coordinator.

In some projects, the project scheduler is not a separate role, because the project manager completes these tasks.

Project Team

The *project team* is the group of individuals who work with the project manager to perform project tasks to ensure the project's completion. Project team members need varied skill sets based on the project requirements. Team members may be removed or added as the project progresses, and they may need to obtain training prior to their inclusion on the team. The project manager must clearly define each team member's responsibilities to ensure that every team member understands all expectations. The project manager may also have to negotiate with functional managers, other project management teams, and/or other organizations to obtain the appropriate team members.

Project team members contribute project expertise and deliverables according to the project schedule. They provide estimations of task duration, costs, and dependencies.

Some of the criteria used by the project manager in the selection of project team members may include availability, cost, experience, ability, knowledge, skills, attitude, and international factors. The project manager also needs to assess whether the team will work face-to-face and/or as a virtual team. Finally, the project manager will need to help the team improve trust between team members in order to raise morale, lower conflict, and increase teamwork.

NOTE Chapter 5, "Personnel and Physical Resource Management," discusses project teams in detail.

Key Topic

Project Management Office (PMO)

The *project management office (PMO)* provides project management governance (including standards and practices) and ensures that resources, methods, tools, and techniques are shared or coordinated across all projects. The PMO sets deliverables, key performance indicators, and other project parameters. It also outlines the consequences of non-performance and provides standard documentation and templates.

PMOs support, control, or direct projects. *Supportive* PMOs supply projects with access to the project knowledge base and exercise low-level project control. *Controlling* PMOs provide the same access but also require compliance with established PMO standards and processes, exercising moderate project control. *Directive* PMOs directly manage all projects and exercise high-level project control.

The PMO supports project managers by identifying and developing project management standards, managing shared resources, monitoring compliance, and coordinating communication. While the project manager focuses on project objectives and manages project resources and constraints, the PMO handles major program scope changes, optimizes the use of shared resources across all projects, and manages risks and interdependencies among projects.

Key Topic

Project Team Structures

Project team structures are controlled by the organization's structure, which affects the availability of resources. Project team structures are categorized as functional, matrix, or projectized. The following sections discuss these categories.

The project manager must understand the project team structure in order to manage the project's resources effectively. The project team structure affects the project manager's role and authority, as well as resource availability, project budget management, and project management administrative staff. Table 2-2 demonstrates how project team structures affect these project characteristics.

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Table 2-2 Influence of Project Team Structures on Projects

Project Characteristic	Functional	Weak Matrix	Balanced Matrix	Strong Matrix	Projectized
Project manager authority	Little or none	Low	Low to moderate	Moderate to high	High to almost total
Resource availability	Little or none	Low	Low to moderate	Moderate to high	High to almost total
Project budget management	Functional manager	Functional manager	Mixed	Project manager	Project manager
Project manager's role	Part-time	Part-time	Full-time	Full-time	Full-time
Administrative staff	Part-time	Part-time	Part-time	Full-time	Full-time

Key Topic

Functional Team Structure

In an organization that uses a *functional team structure*, each employee reports to a single manager or supervisor. Employees are grouped by specialty, such as marketing, sales, or accounting; the specialties may be further subdivided, such as accounts payable and accounts receivable. Because the team members report to a *functional manager*, project managers need to work with the functional manager for resource scheduling.

The project manager has little to no authority in a functional team structure. Because the resource availability rests with the functional manager, project managers need to work with the functional managers for resource scheduling. This collaboration may involve multiple functional managers if team members come from multiple functional areas. In most cases, a functional manager also manages the budget. In this team structure, the project manager is usually not dedicated full-time to managing the project.

In this structure, the project may suffer if functional issues or emergencies arise. If the project may be negatively impacted, the project manager may need to meet with the functional managers and project sponsor regarding team member availability. Figure 2-1 demonstrates project management within a functional organization. In this example, the project team members are taken from multiple functional areas, with each functional manager having authority over the staff members in that functional area.

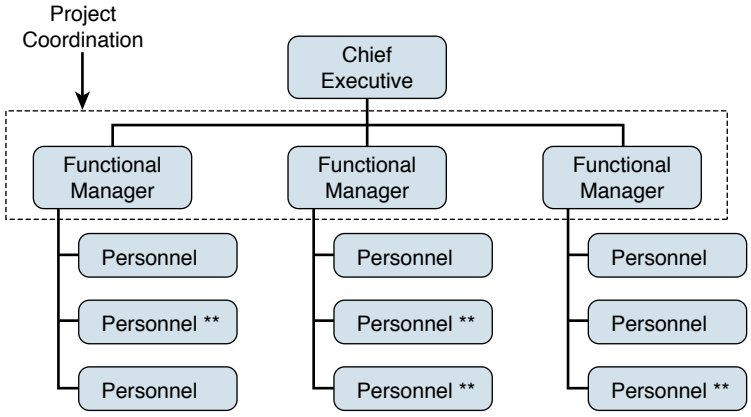


Figure 2-1 Functional Team Structure

Key Topic

Matrix Team Structure

In an organization that uses a *matrix team structure*, each employee usually reports to a functional manager. However, authority is shared between the functional manager and the project manager. Matrix team structures are termed *weak*, *balanced*, or *strong*, depending on the level of power and influence between the functional managers and project managers.

Resources are assigned from the functional area to the project in most cases, but the functional manager usually has the ultimate authority for scheduling. The project manager functions more as a coordinator or expediter.

Figure 2-2 demonstrates project management within a *weak matrix* organization. Some personnel are allocated to the project for project coordination. Other personnel who are part of the project mainly work in their functional departments but are also engaged in project activities.

Figure 2-3 demonstrates project management within a *balanced matrix* organization. In this structure, some personnel are allocated to the project for project coordination. Other personnel who are part of the project mainly work in their functional departments but are also engaged in project activities. In this type of matrix, the project manager is usually a staff member from within one of the functional areas.

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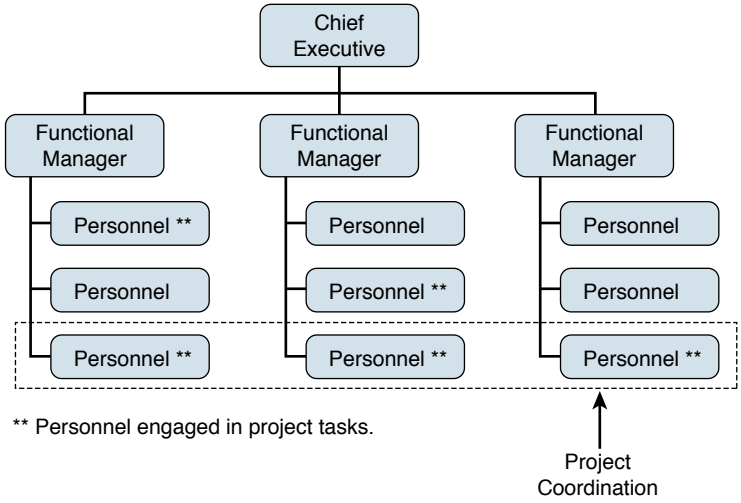


Figure 2-2 Weak Matrix Team Structure

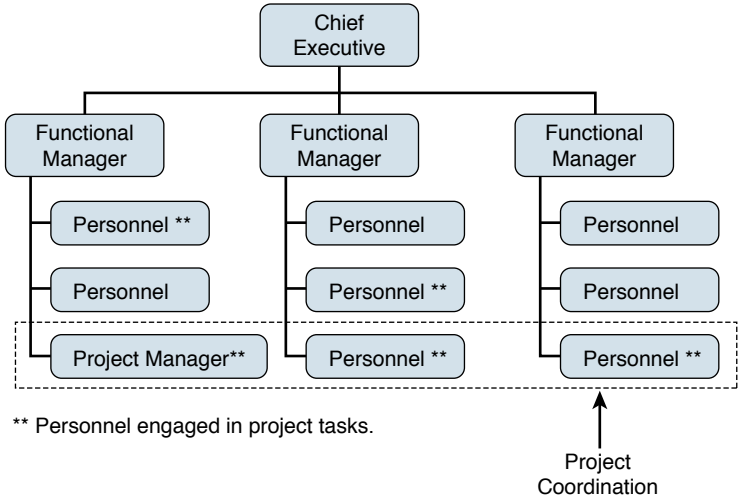


Figure 2-3 Balanced Matrix Team Structure

Figure 2-4 demonstrates project management within a *strong matrix* organization. As in the previous examples, some personnel are allocated to the project for project coordination, and other personnel perform project activities while still mainly working in their functional departments. In this type of matrix, the project manager reports to the manager of project managers within a PMO.

As it moves from a weak matrix to a strong matrix, an organization's team structure comes closer to being projectized.

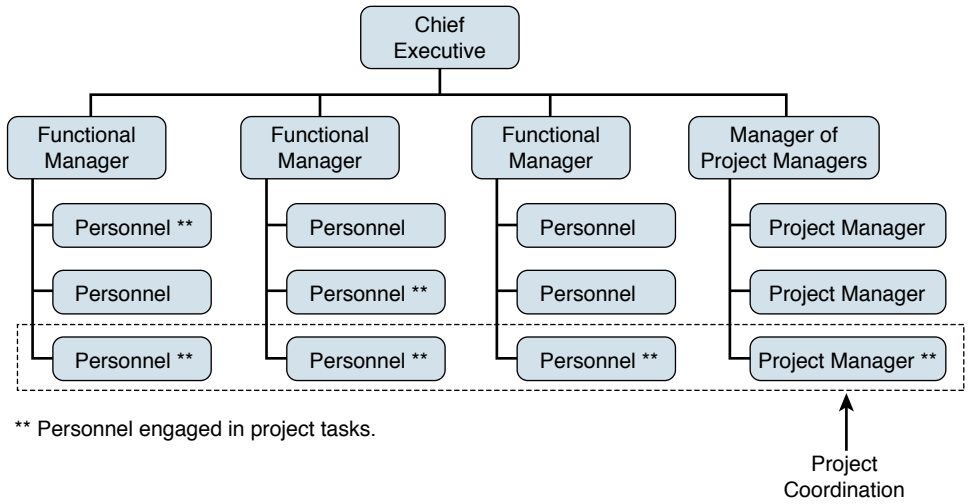


Figure 2-4 Strong Matrix Team Structure

Key Topic

Projectized Team Structure

In an organization that uses a *projectized team structure*, each employee reports to the project manager. The project manager has full authority over all resources. Resources are allocated on an *ad hoc* basis, moving between projects as needed.

Figure 2-5 demonstrates project management within a projectized structure. Within the organization, all personnel are under the authority of a project manager. Project managers work together to ensure that the appropriate resources are available to each of the projects.

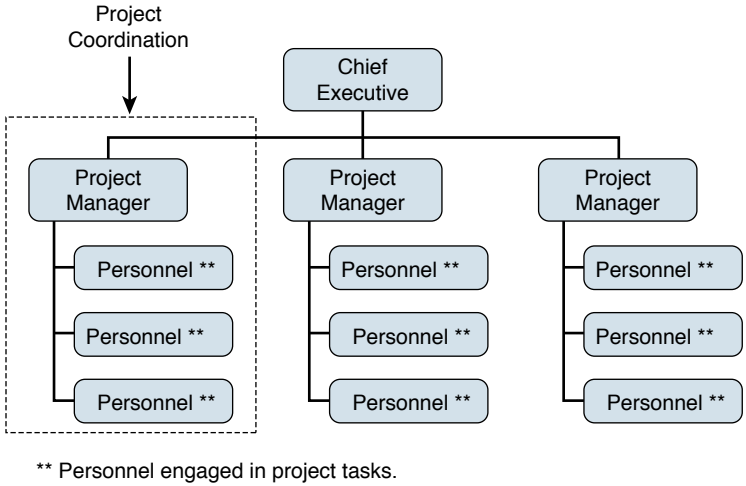


Figure 2-5 Projectized Team Structure

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Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 2-3 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 2-3 Key Topics for Chapter 2

Key Topic Element	Description	Page Number
Section	Overview of *project sponsor* role	33
Section	Overview of *project manager* role	33
Section	Overview of *project coordinator* role	34
Section	Overview of *stakeholder* role	34
Section	Overview of *scheduler* role	35
Section	Overview of *project team* role	35
Section	Overview of *project management office (PMO)*	36
Section; Table 2-2	Overview of *project team structures*	36
Section; Figure 2-1	Overview of *functional team structure*	37
Section; Figures 2-2 through 2-4	Overview of *matrix team structure*	38
Section; Figure 2-5	Overview of *projectized team structure*	40

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

roles, sponsor, project manager, project coordinator, stakeholder, scheduler, project team, project management office (PMO), functional team structure, functional manager, matrix team structure, projectized team structure

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. Your organization has completed a formal project charter and preliminary budget for a new retail app. You need to obtain formal approval of the project. From whom should you obtain approval?
   a. stakeholders
   b. PMO
   c. sponsor
   d. project manager

2. You have been asked to create the project documents for an upcoming project to remodel one of your company's buildings. You will also be responsible for project success and overseeing the project scope, schedule, budget, project team, stakeholders, and quality of the project. Which project role will you fill?
   a. stakeholder
   b. PMO
   c. sponsor
   d. project manager

3. You are the project manager for a project that will research integrating new technology into the air conditioning units that your company produces. You will need access to personnel from multiple departments. The company has offered to hire an individual to support you and provide cross-functional organization. Which role would this new hire fill?
   a. project manager
   b. project coordinator
   c. project team member
   d. stakeholder

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4. You are the project manager for a project to set up a new web server and decommission the old server. You are responsible for selecting the appropriate personnel for the project team. Which of the following is not a responsibility for these team members?
   a. creating the project schedule
   b. contributing expertise to the project
   c. estimating task duration
   d. estimating task costs

5. You are the project manager for a project that will develop new Christmas decoration designs. You must document all individuals and groups who will have a vested interest in this project. Which project role are you identifying?
   a. sponsor
   b. stakeholder
   c. scheduler
   d. PMO

6. You are the project manager for a project that is developing some new flower hybrids. Because this project is much larger than your company's usual projects, the company will add a project role that is solely responsible for ensuring that project time is managed and reported. Which role does this describe?
   a. project coordinator
   b. sponsor
   c. scheduler
   d. PMO

7. You are the project manager for a project that will develop a new line of cosmetics. Your project team includes personnel from several of your company's departments. You have worked with the department managers to negotiate the amount of time that their personnel can spend on your project. Which type of project team structure is in place in your company?
   a. functional
   b. projectized
   c. weak matrix
   d. strong matrix

8. Which project team structure gives the project manager only slightly more authority than the functional team structure?
   a. projectized
   b. strong matrix
   c. balanced matrix
   d. weak matrix

9. Which project team structure gives project managers the most authority?
   a. projectized
   b. strong matrix
   c. functional
   d. weak matrix

10. Which of the following statements regarding project roles is *not* true?
    a. The sponsor provides the high-level requirements and baseline for the project.
    b. The scheduler checks project quality.
    c. The stakeholders provide requirements and project steering.
    d. The PMO sets standards and practices for the organization.

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This chapter covers the following topics:

- **Understand project cost control:** Total project cost, expenditure tracking and reporting, burn rate, cost baseline/budget (plan versus actual), and cost control calculations (including EVM, EAC, ETC, and TCPI).

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Project Cost Control

One of the main limitations for a project is the budget, established during the project's Planning phase. The project manager is responsible for tracking the budget throughout the project. If the budget is insufficient for completing the project, the project manager will have to ask the project sponsor to provide more funds. Project managers therefore must understand and practice careful project cost control.

NOTE A thorough understanding of project schedules is essential for managing project costs. Chapter 4, "Project Schedules," provides details on planning, executing, and revising the schedule for a project.

This chapter covers the following objective for the Project+ exam:

1.4 Identify the basics of project cost control.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 3-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 3-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Cost Baseline	1
Total Project Cost	2
Cost Control Calculations	3–5

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. What activity involves monitoring the project's costs and managing changes to the cost baseline?
   a. cost control
   b. reserve analysis
   c. forecasting
   d. critical path

2. What is total project cost?
   a. all costs specific to a project incurred until the Monitoring and Controlling phase is complete
   b. all costs specific to a project incurred until the Closing phase is complete
   c. provisions in the budget to mitigate cost and/or schedule risks
   d. provisions in the budget to mitigate risks

3. What is the formula for calculating planned value (PV)?
   a. (% of completed work) × budget
   b. EV – AC
   c. (planned % complete) × budget
   d. EV / AC

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4. What does the formula AC + ETC calculate?
   a. EAC for work, including both CPI and SPI
   b. EAC for work performed at current CPI
   c. EAC for work performed at current rate
   d. EAC using calculated ETC

5. What does a TCPI greater than one indicate?
   a. The project is within its scheduled time.
   b. The project is outside its scheduled time.
   c. The project is over budget.
   d. The project is under budget.

Foundation Topics

Cost Baseline

Key Topic

Project cost control involves monitoring the project's costs and managing changes to the cost baseline. The *cost baseline* is the approved project budget. The project budget starts as the cost baseline; however, unlike the cost baseline, the project budget can be changed through formal change control. Project cost control allows project managers to recognize variances from the project plan in order to take corrective action. The project budget and project schedule are closely related. Project managers must understand the relationship between the consumption of project funds and the actual project work being completed.

To properly control costs, project managers must understand total project cost, expenditure tracking and reporting, burn rate, cost baseline/budget (plan versus actual), and cost control calculations (including EVM, EAC, ETC, and TCPI).

Total Project Cost

Key Topic

Total project cost is defined as all costs specific to a project incurred from the Initiating phase to the Closing phase. This value is composed of all the estimated costs in the initial project budget, also known as *total estimated costs (TEC)*, and all other costs related to a project that are not included in the TEC, also known as *other project costs (OPCs)*. OPCs can be formally approved through the change management process or paid for using the project reserves.

NOTE Project reserves are discussed in detail later in this chapter.

Expenditure Tracking and Reporting

Key Topic

Expenditure tracking and reporting helps a project manager to evaluate the project's financial status. Expenditures are usually tracked based on the work breakdown structure (WBS) so that each expenditure can be linked to a specific activity. Each activity or task in the WBS will have associated costs of completing that activity or task, including personnel, procurement, training, travel, and so on.

NOTE The work breakdown structure is discussed in detail in Chapter 4.

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When tracking expenditures, project managers should use the associated WBS code and activity, creating a *cost report* that includes budgeted expenses, actual expenses, and the difference between those two values.

EXAMPLE: Table 3-2 shows an example of an expenditure tracking cost report for a remodeling project. The Demolition activity (WBS code 1.0) includes demolishing the floors, walls, and cabinets. According to this cost report, the wall demolition came in under budget, but the flooring and cabinet demolition was more expensive than projected. Tracking expenditures in this manner helps project managers to quickly identify where/when additional funds are needed.

Table 3-2 Expenditure Tracking Cost Report Example

WBS Code	Activity	Budget	Actual	Budget – Actual
1.0	Demolition	$20,000	$20,450	–$450
1.1	Flooring	$5,000	$5,250	–$250
1.2	Walls	$7,500	$7,000	$500
1.3	Cabinets	$2,500	$3,000	–$500

The project manager is responsible for providing updated cost reports to the appropriate stakeholders as stated in the communication plan, which is part of the project management plan. This task may include sending the cost report to the stakeholders or holding a meeting to discuss the report. In most cases, the communication plan details when the cost report can just be sent to the stakeholders and when a meeting may be needed to discuss issues (such as when costs exceed a certain percentage of the budgeted cost for an activity).

NOTE Project communication and the communication plan are discussed in greater detail in Chapter 9, "Communication Methods and Influences," and Chapter 10, "Communication Triggers and Target Audiences."

Key Topic

Cost Control Calculations

To understand cost control, project managers must first have the project's budget and cost baseline. Once the cost baseline is determined and approved during the Planning phase of the project, the project budget is compared to the cost baseline to determine any deviations. As mentioned previously, the project budget may vary as project changes are approved, but the cost baseline does not change.

To perform cost control, the project manager uses the cost baseline to measure the project's expenditures against its achievements. These calculations show a time-phased view of the budget. Before beginning the cost control calculations, the project manager must derive the planned value, earned value, and actual cost of the work as compared against the cost baseline:

- **Planned value (PV):** Indicates the budgeted cost for the amount of work that is currently completed. The following formula computes PV:

  (planned % complete) × budget

- **Earned value (EV):** Shows the value a project has earned from the money spent to date. The following formula computes EV:

  (% of completed work) × budget

- **Actual cost (AC):** The money spent to date on a project. Calculating AC requires no formula; it is simple addition.

These values quantify the project's progress to date and help analyze how close to budget the project is running.

Earned Value Management (EVM)

Next, the project manager must understand *earned value management (EVM)*. EVM calculations combine scope, schedule, and resource measurements to assess the project's performance, using four EVM formulas:

- **Schedule variance (SV):** The difference between the earned value and the planned value.
- **Cost variance (CV):** The budget deficit or surplus at any given point in time.
- **Schedule performance index (SPI):** The ratio of earned value to planned value.
- **Cost performance index (CPI):** The ratio of earned value to actual cost.

In some cases, a project manager may need to understand *burn rate*, which is simply the rate at which the project budget is being spent. The burn rate is an inverse of CPI.

The SV, CV, SPI, and CPI are all calculated from the PV, EV, and AC. Table 3-3 shows the formulas used to calculate all of the EVM values.

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Table 3-3 Earned Value Management (EVM) Value Calculations

EVM	Formula
Planned value (PV)	(planned % complete) × budget
Earned value (EV)	(% of completed work) × budget
Schedule variance (SV)	EV – PV
Cost variance (CV)	EV – AC
Schedule performance index (SPI)	EV / PV
Cost performance index (CPI)	EV / AC
Burn rate	1 / CPI

EXAMPLE: A project manager has a project to be completed in six months for a total cost of $50,000. The schedule says that three months into the project, 50% of the work should be completed. PV is calculated as follows:

PV = 50% × $50,000

PV = $25,000

In this project, the project manager determines that during those three months, only 40% of the work was completed. EV is then calculated as follows:

EV = 40% × $50,000

EV = $20,000

When completing the cost report, the project manager determines that the amount spent to date is $20,000. This is AC. Now the project manager can compute the variances.

SV is calculated as follows:

SV = $20,000 – $25,000

SV = –$5,000

A positive SV indicates that the project is ahead of schedule, and a negative SV indicates that the project is behind schedule. A value of zero indicates that the project is on schedule. For this example, the project is behind schedule.

CV is calculated as follows:

CV = $20,000 – $20,000

CV = 0

A positive CV indicates that the project is under budget for the amount of work completed, and a negative CV indicates that the project is over budget for the amount of work completed. A value of zero indicates that the cost for the work completed is on budget. For this example, the project is on budget for the amount of work completed.

SPI is calculated as follows:

SPI = $20,000 / $25,000

SPI = 0.8

An SPI value less than one indicates that less work has been completed than planned, and an SPI greater than one indicates that more work has been completed than planned. A value of one indicates that the planned amount of work has been completed in the planned amount of time. For this project, less work has been completed than planned.

CPI is calculated as follows:

CPI = $20,000 / $20,000

CPI = 1

A CPI greater than one indicates that the project is over budget, and a CPI less than one indicates that the project is under budget. A value of one indicates that the budget is proceeding exactly as planned. For this example, the project is on budget.

Finally, the burn rate is calculated as follows:

Burn rate = 1 / 1

Burn rate = 1

A burn rate greater than one indicates that the project is consuming the budget faster than planned and will exhaust the budget before all the work is completed. A burn rate of less than one indicates that the project is consuming the budget slower than planned and will be completed within the budget. A burn rate of one indicates that the project is consuming the budget as planned and will be completed on budget. For this example, the project is on budget.

Forecasting

Forecasting allows the project manager to predict the project's future based on current performance. As a project evolves, the project manager may find it necessary to forecast a new *estimate at completion (EAC)* that is different from the project budget or cost baseline. This situation mainly occurs when project changes have resulted in the need for additional funds, changing the total project cost. For this

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project management technique, the project manager needs to calculate an *estimate to complete (ETC)* value, which provides an approximate idea of how much money will be required to complete the remaining balance of project work. The project manager may also want to compare a range of EAC values for more accurate forecasting. Table 3-4 shows other EAC formulas that can help to factor in various scenarios based on current performance.

Table 3-4 Estimate at Completion (EAC) Value Calculations

EAC	Formula
EAC using calculated ETC	AC + ETC
EAC for work performed at current rate	AC + (budget – EV)
EAC for work performed at current CPI	Budget / CPI
EAC for work including both CPI and SPI	AC + [(budget – EV) / (CPI × SPI)]

EXAMPLE: Returning to the earlier scenario, the following values are determined based on the given parameters:

Budget = $50,000

AC = $20,000

EV = $20,000

CPI = 1

SPI = 0.8

Suppose the project manager determines that the ETC for the remainder of this project is $30,000. The EAC using calculated ETC would be as follows:

EAC = $20,000 + $30,000

EAC = $50,000

This forecast shows no change in the final project cost. However, to derive a range of forecasts, you should also calculate EAC using the three other formulas that represent the EVM values:

EAC for work performed at current rate = $20,000 + ($50,000 – $20,000)

EAC for work performed at current rate = $50,000

EAC for work performed at current CPI = $50,000 / 1

EAC for work performed at current CPI = $50,000

EAC for work including both CPI and SPI = $20,000 + [($50,000 – $20,000) / (1 × 0.8)]

EAC for work including both CPI and SPI = $20,000 + [($30,000) / (0.8)]

EAC for work including both CPI and SPI = $20,000 + $37,500

EAC for work including both CPI and SPI = $57,500

The forecast budget remains the same for most of these calculations except the one that includes both CPI and SPI in the calculation. This result will not always be the case, as the CPI and SPI may or may not match in projects.

To-Complete Performance Index (TCPI)

The project manager may need to measure the required cost performance for the remaining budgetary resources. With this calculation, the project manager must have a specific goal in mind, such as the project budget or one of the EAC values. The EAC value should be used if it is apparent that the cost baseline is no longer viable. To measure this value, the project manager will need to compute the *To-Complete Performance Index (TCPI)*, using one of the following formulas:

TCPI using current budget = (Budget – EV) / (Budget – AC)

TCPI using EAC value = (Budget – EV) / (EAC – AC)

EXAMPLE: Returning to the earlier scenario, we first compute TCPI using the original cost baseline:

TCPI = ($50,000 – $20,000) / ($50,000 – $20,000)

TCPI = 1

Deciding that the EAC calculation with CPI and SPI gives a better forecast, the project manager determines the TCPI by using the other formula as follows:

TCPI = ($50,000 – $20,000) / ($57,500 – $20,000)

TCPI = $30,000 / $37,500

TCPI = 0.8

A TCPI greater than one indicates that the project is under budget, and a TCPI less than one indicates that the project is over budget. A value of one indicates that the budget is proceeding exactly as planned. For this project, the first TCPI value shows that the project is proceeding as planned, but the second TCPI value shows that the project is over budget.

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NOTE Do not just memorize these formulas—practice using them. Come up with your own project scenarios, and then complete these calculations. The "Review Questions" section at the end of this chapter also holds some examples.

Reserve Analysis

Reserve analysis is a method of determining funds that are held to account for any cost uncertainty that the project may encounter. To understand reserve analysis, project managers must first understand *project reserves*, which are provisions in the budget to mitigate cost and/or schedule risks. Two types of project reserves are used in most projects: management reserves and contingency reserves.

A *management reserve* is a portion of the project budget that is held for management control purposes, mainly used when unforeseen work is needed to complete the project's scope. This type of reserve specifically addresses unknown risks. The management reserve is not included in the cost baseline but is part of the budget requirements. The arbitrary figure is determined by the project sponsor and project manager. Management reserves become part of the budget only if they are used.

A *contingency reserve* is a portion of the project budget that is allocated for project risks. This type of reserve specifically addresses identified risks. If a specific risk occurs, then the portion of the contingency reserve allocated for that risk is spent. These reserve amounts are usually calculated using probability and impact calculations. Contingency reserves are part of the cost baseline and budget requirements.

Management reserves can be used at the discretion of the project manager, often in agreement with the project sponsor. Contingency reserves are usually used only if a particular risk occurs, and then only the portion of the contingency reserve allocated for that risk. Unused reserves should be returned to the project sponsor during project closure, unless the project management plan states differently.

Change Requests

Cost performance analysis may result in a change request to the cost baseline, project schedule, or other parts of the project management plan. Change requests should be processed as part of the change control process. If the change is approved and involves funding changes, the budget will need to be revised.

NOTE The change control process is discussed in more detail in Chapter 11, "Change Control."

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 3-5 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 3-5 Key Topics for Chapter 3

Key Topic Element	Description	Page Number
Section	Overview of *cost baseline*	50
Section	Overview of *total project cost*	50
Section; Table 3-2	Overview and example of *expenditure tracking and reporting*	50
Section; Tables 3-3 and 3-4; examples	Overview, formulas, and examples for *cost control calculations*	51

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

cost control, total project cost, cost report, total estimated costs (TEC), other project costs (OPCs), cost baseline, budget, planned value (PV), earned value (EV), actual cost (AC), earned value management (EVM), cost variance (CV), cost performance index (CPI), burn rate, estimate at completion (EAC), estimate to complete (ETC), To-Complete Performance Index (TCPI), reserve analysis, project reserve, management reserve, contingency reserve, work breakdown structure (WBS)

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Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. You have a project to be completed in 12 months, and the total cost of the project is $1,000,000. Six months have passed, and the schedule says that 40% of the work should be completed. What is the project's planned value (PV) at this point?
   a. $600,000
   b. $100,000
   c. $900,000
   d. $400,000

For questions 2–7, refer to the following scenario: You have a project to be completed in 12 months, and the total cost of the project is $1,000,000. Six months have passed. On closer review, you find that only 40% of the work has been completed so far, but the schedule indicates that 60% of the work should be complete.

2. The project has spent $600,000. What is the project's actual cost (AC) at this point?
   a. $100,000
   b. $1,000,000
   c. $600,000
   d. $400,000

3. What is the project's earned value (EV) at this point?
   a. $600,000
   b. $400,000
   c. $1,000,000
   d. $240,000

4. What is the project's schedule variance (SV) at this point?
   a. $200,000
   b. –$200,000
   c. $100,000
   d. –$100,000

5. What is the project's cost variance (CV) at this point?
   a. $400,000
   b. $0
   c. $200,000
   d. –$200,000

6. What is the project's schedule performance index (SPI) at this point?
   a. .5
   b. 1
   c. 1.5
   d. .67

7. What is the project's cost performance index (CPI) at this point?
   a. 1
   b. 1.5
   c. .67
   d. .5

8. You need to determine the burn rate for a current project. Which of the following is the correct formula to use?
   a. 1 / CV
   b. 1 / SV
   c. 1 / SPI
   d. 1 / CPI

9. You need to determine if a project is over or under budget. When you complete the CV calculation, you obtain a value of –$43,000. What does this value indicate?
   a. The project is under budget for the amount of work completed.
   b. The project is over budget for the amount of work completed.
   c. The work completed is on budget.
   d. More work has been completed than planned.

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10. Management contacts you requesting the burn rate for the project you are currently managing. Your burn rate calculation is .75. What does this value indicate?

- **a.** The project is consuming the budget slower than planned.
- **b.** The project is consuming the budget faster than planned.
- **c.** The project is consuming the budget as planned.
- **d.** The budget will be exhausted before all the work is completed.



This chapter covers the following topics:

- **Understand project schedules:** Work breakdown structure (WBS) and scheduling activities.

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Project Schedules

One of the main limitations for a project is the schedule, established during the project's Planning phase. The project manager is responsible for managing the schedule throughout the project. If task durations take longer than originally estimated, either more resources will need to be provided or the project end date will have to be changed. Project managers therefore need to manage project schedules carefully.

NOTE A thorough understanding of project costs is essential for planning project schedules. See Chapter 3, "Project Cost Control," for details on planning and controlling the costs associated with a project.

This chapter covers the following objective for the Project+ exam:

1.6 Given a scenario, execute and develop project schedules.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 4-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 4-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Work Breakdown Structure (WBS)	7
Scheduling Activities	1–6, 8–10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. What is a task relationship called if task B relies on the completion of task A and should start after task A is complete?
   - **a.** dependency
   - **b.** predecessor
   - **c.** critical path
   - **d.** float

2. What is the critical path?
   - **a.** the sequence of tasks comprising the project path that take the shortest amount of time
   - **b.** the sequence of tasks comprising the project path that takes the longest amount of time
   - **c.** a list of all the tasks needed to complete a project
   - **d.** the approved version of the project schedule

3. What is the method for determining the LS and LF of project tasks?
   - **a.** Starting with the first task(s), the project manager performs a backward pass through all the tasks.
   - **b.** Starting with the first task(s), the project manager performs a forward pass through all the tasks.
   - **c.** Starting with the last task(s), the project manager performs a backward pass through all the tasks.
   - **d.** Starting with the last task(s), the project manager performs a forward pass through all the tasks.

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4. What is the WBS used to determine?
   a. project costs
   b. project tasks
   c. project risks
   d. project changes

5. What is the float for a task?
   a. the sequence of tasks comprising the project path that takes the longest amount of time
   b. the difference between the ES and EF values for the task
   c. the difference between the LS and LF values for the task
   d. the difference between the LS and ES values for the task

6. Which project schedule component provides acceptance criteria to ensure that project tasks are completing deliverables within the quality control guidelines established during project planning?
   a. critical path
   b. governance gates
   c. milestones
   d. quality gates

7. Which project document subdivides the project work into manageable components?
   a. project schedule
   b. project budget
   c. work breakdown structure
   d. resource breakdown structure

8. What is a task called if it must be completed prior to starting the next task?
   a. dependency
   b. predecessor
   c. critical path
   d. float

9. What are milestones?
   a. significant events in a project
   b. the tasks in the project path that take the longest amount of time
   c. acceptance criteria used to ensure that project tasks are completing deliverables within the quality control guidelines
   d. points in a project when the project manager must obtain formal approval prior to proceeding with the project

10. What is used to calculate each task's ES, EF, LS, and LF?
    a. TCPI
    b. forecasting
    c. critical path
    d. EAC

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Foundation Topics

Creating the project schedule involves performing time-management activities to determine the project tasks, task durations, and task dependencies. The approved project schedule can be changed only through formal change control. Project schedule control allows project managers to recognize variances from the project plan and take corrective actions. Because the project schedule and project budget are closely related, project managers must understand the relationship between the completion of project tasks and the consumption of project funds.

To create the project schedule, the project manager must create the work breakdown structure and then perform the scheduling activities.

Key Topic

Work Breakdown Structure (WBS)

The *work breakdown structure (WBS)* is a project document that subdivides the project's work into manageable components. To create the WBS, project managers should use decomposition and a top-down approach to break the project deliverables into separate pieces. The top level of the WBS is the project itself, and the second level of the WBS is usually the project's main phases. The third level contains the project deliverables, and the fourth level is the individual tasks to create the project deliverables. However, keep in mind that an organization may have an established WBS template that follows a structure designed for the organization's specific needs.

The WBS ends when the project manager has defined the individual *work packages*, which are the smallest units of work in the WBS. Each work package is then assigned a control account and a unique identifier. These assignments make it easy to provide work package tracking of scope, budget, actual cost, and schedule. The WBS includes a *WBS dictionary* that provides deliverable, activity, and scheduling information about each WBS component.

EXAMPLE: Table 4-2 shows the WBS for a charity dinner event. This event is broken into six main components: Planning & Supervision, Dinner, Room & Equipment, Guests, Staff, and Speakers.

Table 4-2 Example of a Work Breakdown Structure

1.0	Charity Dinner								
		1.1	Planning & Supervision						
				1.1.1	Planning				
				1.1.2	Budget				
				1.1.3	Coordination				
		1.2	Dinner						
				1.2.1	Menu				
				1.2.2	Shopping List				
				1.2.3	Shopping				
				1.2.4	Cooking				
				1.2.5	Serving				
		1.3	Room & Equipment						
				1.3.1	Site/Room				
				1.3.2	Tables/Chairs				
				1.3.3	Settings/Utensils				
				1.3.4	Decorations				
				1.3.5	Cooking Equipment				
		1.4	Guests						
				1.4.1	Guest List				
				1.4.2	RSVPs				
				1.4.3	Name Tags				
				1.4.4	Special Needs				
						1.4.4.1	Dietary Needs		
						1.4.4.2	Accessibility		
		1.5	Staff						
				1.5.1	Shoppers				
				1.5.2	Cooks				
				1.5.3	Servers				

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		1.5.4	Hosts
		1.5.5	Setup/Takedown
	1.6 Speakers		
		1.6.1	Invite/Accept
		1.6.2	Transport
		1.6.3	Coordinate Topics
		1.6.4	Backups for No-Shows
		1.6.5	Thank You Notes

In this example, the 1.4 Guests deliverable includes four main tasks:

- 1.4.1 Guest List
- 1.4.2 RSVPs
- 1.4.3 Name Tags
- 1.4.4 Special Needs

Task 1.4.4 Special Needs is further divided into two subtasks:

- 1.4.4.1 Dietary Needs
- 1.4.4.2 Accessibility

The project manager may have anticipated all of these tasks or may have worked with other experts to determine the tasks. For example, the Dietary Needs task (1.4.4.1) would likely be added during dinner planning when the menu planners ask about it, and the Accessibility task (1.4.4.2) would likely be added when planning the room reservation and audiovisual equipment for the event.

Keep in mind that full decomposition of project tasks may not be possible at the early stages of the project. The project team will not work to decompose a deliverable until they all agree on the full scope of that deliverable. *Roll wave planning* is a method whereby planning for future deliverables occurs when the project is closer to that deliverable being needed. This technique uses detailed planning for closer activities and high-level planning for activities that will be performed in the future. As the project progresses and requirements become clearer, more detailed planning is done for the work packages at lower levels of the WBS.

The WBS must represent the entire project's work, including the full scope of the project and all purchases or procurements.

Scheduling Activities

After breaking the project into its individual components and documenting them in the WBS, the project manager can use the WBS to schedule all project activities. Creating the schedule is probably one of the most time-consuming tasks for any project because of the amount of coordination required in the process:

1. Determine the tasks.
2. Determine the project's milestones.
3. Determine each task's durations and start/finish dates.
4. Set predecessors and dependencies.
5. Sequence and prioritize the tasks.
6. Determine the critical path.
7. Allocate project resources to the individual tasks.
8. Set the schedule baseline.
9. Set the quality gates.
10. Set the governance gates.

Determine Tasks

Once the WBS is completed, the project manager can then determine the tasks that must be completed. In some cases, these tasks may come directly from the WBS. If subtasks need to be included, the project manager creates a *task list* of all the tasks needed to complete the project. Each task must have a unique name and should be tracked back to a WBS component. Each task should match with the work packages in the WBS. Multiple tasks may be assigned to a work package.

EXAMPLE: Most of the individual 1.x.x and 1.x.x.x components in our charity dinner WBS are tasks, but some could be divided into subtasks. If the tables and chairs will come from different vendors, for instance, the project manager might subdivide the Tables/Chairs task (1.3.2) into two subtasks.

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Key Topic

Determine Milestones

Milestones are significant events in a project. The *milestone list* identifies all project milestones and indicates whether each milestone is mandatory. Milestones are incorporated into the project schedule, but they do not have durations because they are not actually project tasks. Rather, milestones are points in time that are reached as a project progresses.

EXAMPLE: For our charity dinner WBS, one project milestone might be when all the cooking components for the dinner are purchased or obtained. This would only occur after tasks 1.2.1–1.2.3. Another project milestone might be when all the "human" components for the dinner are verified, which would occur after tasks 1.4.1–1.4.2, 1.5.1–1.5.5, and 1.6.1 are complete.

NOTE For details on working with task sequencing relationships, see Chapter 10, "Communication Triggers and Target Audiences."

Key Topic

Determine Task Durations and Start/Finish Dates

Once the tasks are documented, the project manager needs to determine each task's *duration*—how long the task will take to complete. It is important that the project manager work with the project team to get help in these task duration estimates. Once the task durations are created, then the project manager can determine start and finish dates for each task.

EXAMPLE: For our charity dinner WBS, the duration to complete the guest list (task 1.4.1) is likely to take less time than obtaining the RSVPs (task 1.4.2). So while the project manager might assign only two days for creating the guest list and sending out invitations, obtaining the RSVPs is likely to take several weeks. It may even be necessary to assign someone to contact any individuals who have not responded. This extra task would be added to the task list at that time, perhaps as "Guest List Follow-up" subtask 1.4.1.1.

Key Topic

Set Predecessors and Dependencies

Now that the task list is complete (or as close to complete as it can be made at this time), the project manager must determine task predecessors and dependencies. A *predecessor* is a task that must be completed prior to starting the next task. A task that follows the predecessor, called a *dependency*, relies on the completion of the earlier task.

EXAMPLE: For our charity dinner WBS, the project team cannot create the shopping list (task 1.2.2) until the menu has been determined (task 1.2.1). In addition,

cooking the dinner (task 1.2.4) cannot be completed until after someone has done the shopping (1.2.3), obtained cooking equipment (task 1.3.5), and hired the cooks (task 1.5.2).

Key Topic

Sequence and Prioritize Tasks

Once the task predecessors and dependencies are documented, the project manager can put the tasks into the sequence (called a *path* or *pathway*) in which the tasks need to be completed. Prioritizing tasks ensures that if two tasks have a conflict, the task with the higher priority will be given the necessary resources.

In sequencing and prioritizing tasks, the project manager will develop a schedule that likely has multiple paths to completion. These paths become an important factor in the next step, determining the critical path.

EXAMPLE: Our charity dinner event would have several project pathways. Figure 4-1 shows an example of a schedule for the tasks contained in task 1.2. This figure is an example of a Gantt chart.

The project manager has scheduled the menu (task 1.2.1) and shopping list (task 1.2.2) tasks to occur early in the project. However, shopping for the supplies (task 1.2.3) must occur closer to the actual event date. In addition, cooking (task 1.2.4) and serving (task 1.2.5) will not occur until the day of the event.

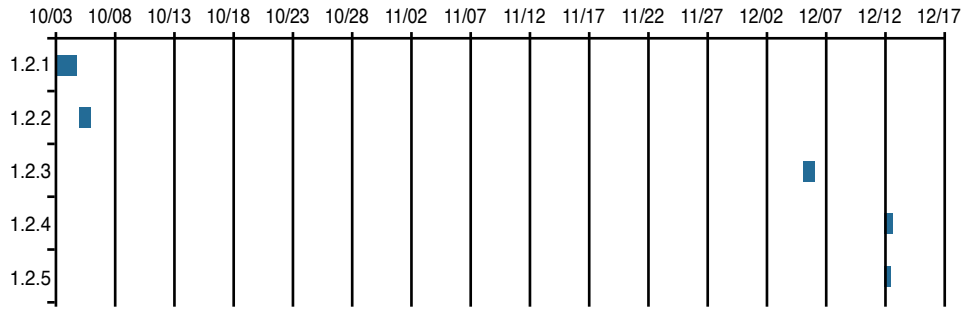


Figure 4-1 Example of a Project Schedule

Key Topic

Determine Critical Path

With the sequences and priorities of the tasks determined, the project manager is ready to find the critical path for the project. The *critical path* represents the project path that will take the longest amount of time to complete. This critical path also

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defines the shortest possible duration for a project—activity time that cannot be cut or compressed if the project is to succeed.

To calculate the critical path, the project manager determines the duration of each path by adding the task durations within each project path. The path with the longest duration is considered the critical path.

EXAMPLE: Figure 4-2 shows a sample project with tasks designated as A through P. The duration (D=) of each task is listed above the task.

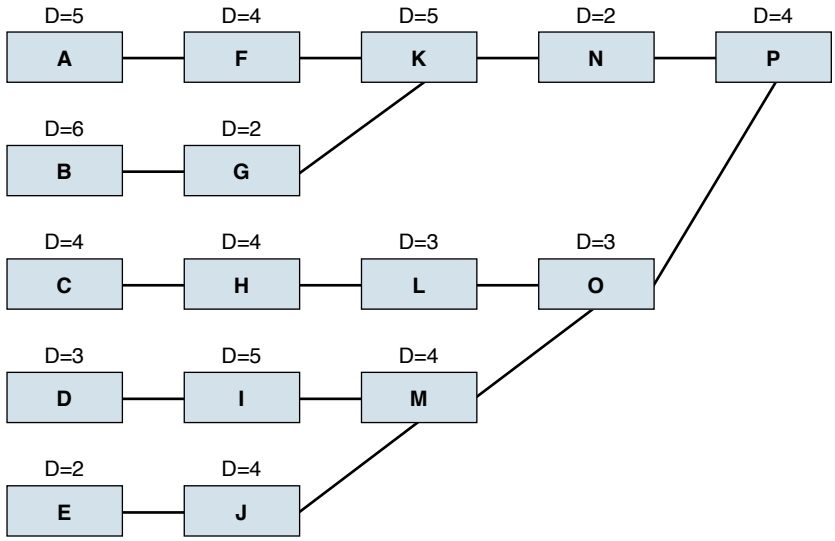


Figure 4-2 Example of a Path Grid

The diagram in Figure 4-2 is a common chart type used to calculate the critical path of a project and show the task dependencies. In this example, task N depends on the completion of task K, while task K depends on the completion of tasks F and G.

The chart in Figure 4-2 holds a total of five project paths:

- A – F – K – N – P
- B – G – K – N – P
- C – H – L – O – P
- D – I – M – O – P
- E – J – M – O – P

To determine the critical path, the project manager adds the durations for each task within each path to obtain the following values:

- A – F – K – N – P = 5 + 4 + 5 + 2 + 4 = 20
- B – G – K – N – P = 6 + 2 + 5 + 2 + 4 = 19
- C – H – L – O – P = 4 + 4 + 3 + 3 + 4 = 18
- D – I – M – O – P = 3 + 5 + 4 + 3 + 4 = 19
- E – J – M – O – P = 2 + 4 + 4 + 3 + 4 = 17

Based on those calculations, the critical path for this project is A–F–K–N–P. Depending on the units used, this could be 20 days or 20 hours. For this example, we will use days, with each day being an eight-hour workday.

After determining the critical path, the project manager can calculate the *early start (ES)*, *early finish (EF)*, *late start (LS)*, and *late finish (LF)* for each task. These values will be entered into a grid and used to calculate the *float* (also called *slack*). Float is the difference between the LS and ES values for a task, and it shows which tasks have some leeway for moving versus tasks with fixed points in the schedule. Figure 4-3 shows an example of a task grid.

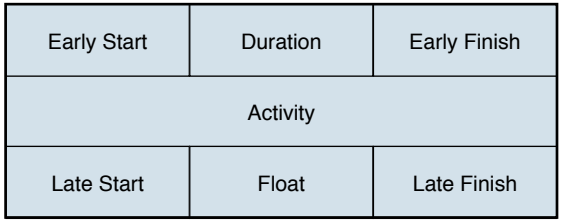


Figure 4-3 Task Grid for Determining Critical Path

The calculations can start from 0 or from 1, following the standard set by the project management office (if any). No matter which value is used, the calculations are basically the same. For this example, the project starts at 0.

The ES is the earliest start date for each task, and the EF is the earliest finish date for each task. The method used for calculating ES and EF is often referred to as a *forward pass*. For the first task in any critical path, the ES will be 0 (or 1). The EF for the first task in any critical path is the same as the duration. Task A, the first task in our example (refer to Figure 4-2), has a duration of 5 days, giving it an ES of 0 and an EF of 5.

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To calculate ES and EF for other tasks in the critical path, the ES is the same as the EF value of the previous task. The EF of the task is the duration of the task added to the ES of the task. In this example, the ES for task F is the same as the EF of task A (5). Task F's duration (4), added to its ES (5), results in a calculation of 9 days for task F's EF.

Calculating ES can get tricky if a task depends on multiple predecessors. An example is task K in Figure 4-2, which is dependent upon both task F and task G. Calculating the ES and EF of task K is impossible without knowing the EF of task B and task G. For task B, the ES is 0, and the EF (duration) is 6. For task G, the ES is 6, and the EF is 8. Now the project manager must compare the EF of task F (9) to the EF of task G (8). The ES of a dependent task is the latest date of its predecessors. In this case, 9 is greater than 8; therefore, task K will have an ES of 9.

The project manager will continue with this method until all tasks have ES and EF values. Once these values are complete, it is possible to determine the LS and LF for each task and calculate the float. Tasks with a float of 0 are critical tasks; they must be started and completed on time because they allow no movement in the schedule.

To start calculating LS and LF, the project manager starts with the last task(s) and performs a *backward pass* through all the tasks, determining each task's late start and late finish. The LS and LF for the last task is the same as the ES and EF for that task. In our example, task P should have ES and LS values of 16 and EF and LF values of 20.

Working backward, a task's LF is equal to the LS of the task after it. So task N's LF is 16. To get a task's LS, subtract the duration from the LF. For task N, the LS is 14.

Task O is also a predecessor of task P and will give us a chance to compute float. The LF for task O is the LS of task P, which is 16. The LS for task O is 13 (LF minus duration). To calculate float, compare the ES and LS for the task. Task O's ES is 12 and LS is 13. Therefore, float for this task is 1, meaning that this task could lag by 1 day without negatively affecting the project.

TIP Wondering why task O's ES is not the same as task L's EF? Because task O also depends on task M. If task O depended only on task L, task O's ES would be 11. However, because it is also dependent on task M, task O's ES is the later value (12). The same principle applies to the ES for tasks K, M, and P.

The project manager will keep performing these steps until the LS and LF fields are complete. Figure 4-4 shows the completed critical path grid for this example.

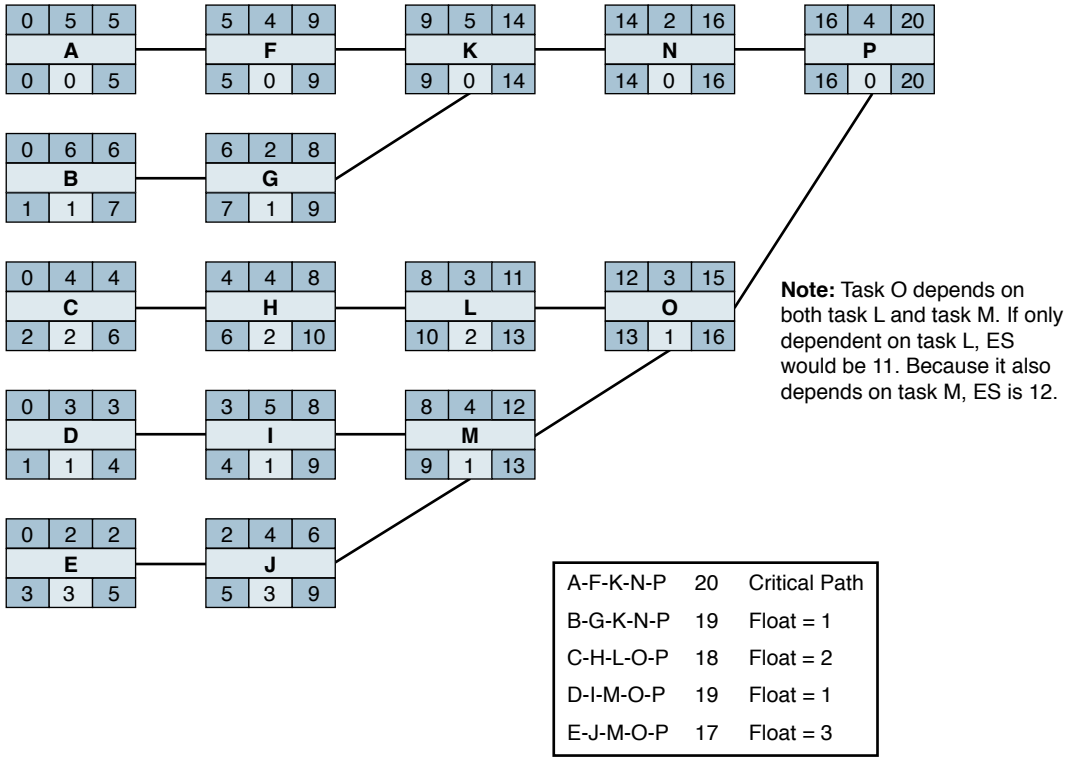


Figure 4-4 Critical Path Calculations

Completing critical path calculations is time-consuming. Many project management tools include templates to help project managers with these calculations. But no matter which method is used, the critical path calculations are an important part of creating the schedule. To ensure that you fully understand this process, practice working out critical path calculations with various examples.

Key Topic

Allocate Resources

After completing all of the task scheduling activities, the project manager needs to allocate resources to each project task. Resources that could be allocated include materials, personnel, equipment, supplies, and so on.

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All resources must be documented in a *resource breakdown structure*, which breaks down allocated resources hierarchically by category and type. The time during which those resources are available is listed in the *resource calendar*, which shows the resources needed for each of the project tasks. For resources such as materials and supplies, which may take days or weeks to deliver, the project manager may also need to document lead times for ordering. For example, if a new IT project requires purchased equipment to be available at a certain point in the project, the project manager must determine from the vendor exactly how long after the order date the equipment will be produced and delivered. Of course, all of this information is in the procurement documentation, but this information must also be documented in the resource calendar to help with developing the project schedule.

The project manager uses resource calendars to match resources with the various project tasks and durations documented in the WBS. Using resource optimization techniques such as resource leveling and resource smoothing, the project manager can develop the project schedule. *Resource leveling* adjusts the task's start and finish dates based on resource constraints and might increase the original critical path. *Resource smoothing* adjusts the activities within their float amounts so that the resource requirements do not exceed the limits of available resources. For each task in the project schedule, all resources must be documented.



Set Baseline

The *schedule baseline* is the approved version of the project schedule. A project's time management is always measured against the original schedule baseline. The project schedule can be adjusted only through the formal change control process.

NOTE For details on the change control process, see Chapter 11, "Change Control."

Set Quality Gates

As part of schedule development, project managers may establish *quality gates*, which provide acceptance criteria to ensure that project tasks are completing deliverables within the quality control guidelines established during project planning. Quality gates are most often carried out between project phases but can also be completed during other transitional periods.

EXAMPLE: An organization requires a third-party service at a certain point in a project. Service levels were previously negotiated with the third party and

documented in a formal service-level agreement (SLA). The project manager knows that the appropriate service level is vital to project success. As soon as the service is available, the project manager should set a quality gate to test the available service level to ensure that it meets the promised levels.

Quality gates usually have an associated checklist to provide parameters for determining whether quality measurements are being met. A quality gate is unlocked and the project can proceed once all the measurable parameters are achieved.

Set Governance Gates

A *governance gate* is similar to a quality gate in that it marks acceptance criteria for the project tasks, but a governance gate is more about client sign-off, management approval, or legislative approval. The key word here is *approval*. A governance gate should be set up whenever the project manager must obtain formal approval prior to proceeding with the project activities.

EXAMPLE: An organization needs a state governing body to approve certain aspects of a project as complying with a new regulation. The project should include a governance gate (or multiple governance gates, depending on complexity) to ensure that the appropriate approval is obtained. Setting the governance gate ensures that the project can be revised to meet governance criteria if its initial approval is denied.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 4-3 provides a reference of these key topics and the page number on which each begins.

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Key Topic

Table 4-3 Key Topics for Chapter 4

Key Topic Element	Description	Page Number
Section; example; Table 4-2; lists	Overview and example of *work breakdown structure (WBS)*	67
Section; list	Overview of *scheduling activities*	70
Section; example	Overview and example of *tasks*	70
Sections; example	Overview and example of *milestones*	71
Section; example	Overview and example of *task durations* and *start/finish dates*	71
Section; example	Overview and example of *predecessors* and *dependencies*	71
Section; example; Figure 4-1	Overview and example of sequencing and prioritizing *paths* in a project schedule	72
Section; lists; examples; Figures 4-2 through 4-4	Overview and examples of *task grids* and *critical path*	72
Section	Overview of *resource breakdown structure* and *resource calendar*	76
Sections; examples	Overview of *schedule baseline*, *quality gates*, and *governance gates*	77

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

work breakdown structure (WBS), work package, WBS dictionary, roll wave planning, task list, milestone, milestone list, duration, predecessor, dependency, path, critical path, early start (ES), early finish (EF), float, forward pass, late start (LS), late finish (LF), backward pass, resource breakdown structure, resource calendar, resource leveling, resource smoothing, schedule baseline, quality gate, governance gate

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. A project has the tasks shown in Figure 4-5, with the durations shown in the following table.

Task	Duration
Task A	10 days
Task B	3 days
Task C	2 days
Task D	4 days
Task E	3 days
Task F	2 days
Task G	4 days
Task H	5 days
Task I	3 days
Task J	4 days
Task K	1 day
Task L	3 days
Task M	2 days

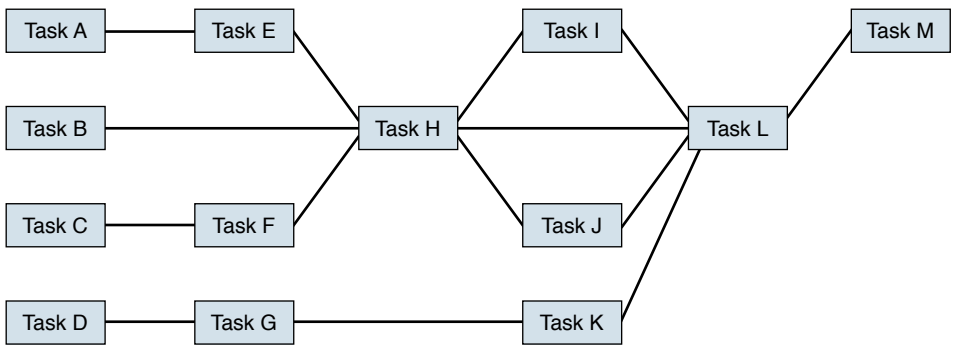


Figure 4-5 Project Tasks

Which path is the critical path for this project?

a. A–E–H–I–L–M

b. A–E–H–J–L–M

c. C–F–H–I–L–M

d. C–F–H–J–L–M

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2. Continuing the scenario in question 1, what is the early start (ES) of task E, assuming that the ES of task A is 0?
   a. 1
   b. 2
   c. 3
   d. 10

3. Continuing the scenario in question 1, what is the early finish (EF) of task E, assuming that the ES of task A is 0?
   a. 13
   b. 11
   c. 10
   d. 9

4. A team member contacts you regarding an event on the project calendar that has no duration. What is this event?
   a. float
   b. milestone
   c. slack
   d. dependency

5. Which two values are used to determine the float of a project task?
   a. LS and LF
   b. LF and EF
   c. LS and ES
   d. LF and ES

6. What document lists allocated resources hierarchically by category and type?
   a. resource list
   b. resource calendar
   c. work breakdown structure
   d. resource breakdown structure

7. Which of the following is included in project schedules to ensure that required approvals are obtained?
   a. governance gate
   b. quality gate
   c. work breakdown structure
   d. milestone

8. Which values are determined during a forward pass?
   a. ES and LS
   b. ES and EF
   c. EF and LF
   d. LS and LF

9. What technique might increase the critical path?
   a. resource smoothing
   b. forward pass
   c. resource leveling
   d. backward pass

10. A project stakeholder is concerned that certain project tasks are slipping and will affect the project's final completion date. Which project document will help you determine if this is true?
    a. critical path
    b. resource calendar
    c. cost baseline
    d. schedule baseline

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This chapter covers the following topics:

- **Understand personnel management:** Team building, trust building, team selection, skill sets, remote versus in-house personnel resources, personnel removal/replacement, communication issues, and conflict resolution.
- **Understand resource management concepts:** Shared and dedicated resources; resource allocation, shortage, and overallocation; low-quality resources; benched resources; and interproject dependencies and resource contention.

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Personnel and Physical Resource Management

Projects use personnel and other physical resources. During the project's Planning phase, the project manager should establish the project's personnel and other physical resource needs. Personnel needed for the project includes the project team members and stakeholders. Other physical resources may include equipment, supplies, and items to be purchased (procurements). For example, a construction project could include all the personnel to provide the labor for building, but it might also include equipment such as dump trucks and tools, supplies such as cement and electrical wiring, and so on. If even one of its resources is not available at the correct time, an entire project could be delayed.

This chapter covers the following objective for the Project+ exam:

1.8 Explain the importance of human resource, physical resource, and personnel management.

NOTE Depending on the organization and project, personnel may or may not be considered part of the project's resources. For the Project+ exam, CompTIA regards personnel as a resource. However, even if the people working on a project are counted among the project's resources, they still are managed as part of personnel management, not resource management. This chapter first focuses on the topic of personnel management and then discusses management of other resources.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own

assessment of your knowledge of the topics, read the entire chapter. Table 5-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 5-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Personnel Management	1–4
Resource Management	5–10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which of the following statements describes storming?
   a. The team meets and learns about how they will work together in the project.
   b. The team starts working together.
   c. The team starts making decisions about the project.
   d. The team starts working as a unit.

2. Which term is used for personnel who are assigned to the project from the start, based on their positions in the organization or their knowledge and skill sets?
   a. acquired resources
   b. preassigned resources
   c. negotiated resources
   d. benched resources

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3. Which conflict-resolution technique involves emphasizing areas of agreement rather than differences?
   a. smoothing
   b. forcing
   c. compromising
   d. confronting

4. Which conflict-resolution technique should you use as a last resort to resolve a long-lasting conflict?
   a. compromising
   b. confronting
   c. avoiding
   d. forcing

5. What does the term *shared resources* describe?
   a. used jointly between multiple projects
   b. allocated to a single project
   c. including both in-house and remote personnel
   d. allocated to a project but not currently assigned to a specific project activity or task

6. Which of the following conditions is most likely to cause delays in the project schedule?
   a. resource overallocation
   b. resource shortage
   c. shared resources
   d. benched resources

7. What should a project manager do to ensure that low-quality resources are not used in the project?
   a. use only in-house personnel resources to complete project tasks
   b. use only dedicated resources to complete project tasks
   c. consult with experts to ensure that the resource specifications are listed in the project documentation
   d. bench all resources that are considered low-quality

8. Which term describes resources that are available for project usage but are not being utilized?
   a. shared resources
   b. idle resources
   c. in-house resources
   d. benched resources

9. Which of the following is an issue when resources are used by multiple projects that have overlapping schedules?
   a. resource overallocation
   b. resource contention
   c. benched resources
   d. remote resources

10. Which of the following statements is false?
    a. Interproject dependencies occur when one project must wait for another project to complete results that are needed by the first project.
    b. When projects share resources, each of the projects depends on the other projects to release resources in a timely manner to ensure project success for all.
    c. A variety of factors could help in deciding which project gets a contended resource first.
    d. Regardless of organizational structure, the project manager must decide which project gets priority.

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Foundation Topics

Personnel Management

Personnel management ensures that the individuals who are part of the project team or who have a vested interest in the project are identified and managed appropriately. As discussed in Chapter 2, "Project Roles, Responsibilities, and Team Structures," the Planning phase of a project includes identifying all these stakeholders and the members of the project team. Stakeholders can affect the project's outcome but usually do not actually complete project work. Project team members are individuals who have the expertise needed to complete the project, and they work together on project activities. The project manager is responsible for ensuring that the project team can work well together.

The project manager must have the appropriate skills to manage personnel, including team building and trust building. The team members' skill sets affect team selection and performance, and team members' locations (remote and/or in-house) affect how the team is managed. The project manager also handles personnel removal or replacement on the team and must be able to resolve communication issues and conflicts.

Key Topic

Team Building and Trust Building

The project manager must assemble a competent project team in order to complete the project's activities. Some project team members may be selected and assigned to the project in advance, particularly personnel with specific skills needed to complete the project. In other cases, the project manager may need to negotiate to obtain staff members for the team. These negotiations may involve functional managers, other project teams and project managers, external organizations, and/or a project management office (PMO). Finally, it may be necessary to hire team members or subcontract work to third parties. No matter how the team is assembled, the project manager must help the team during the team-building process.

Team building is a never-ending process. Even after a team matures, team-building efforts should be regularly renewed or continued. The project manager should work with team members to ensure that the team moves through the team-building stages identified in the Tuckman ladder:

- **Forming:** The team meets and learns about how they will work together in the project. During this stage, team members may not yet be open to trusting each other. The team members focus more on tasks than communication in this stage.

- **Storming:** The team starts making decisions about the project. Because this stage requires collaboration and conflict resolution, team members should be open to differing ideas and perspectives.
- **Norming:** The team starts working together, and team members adjust their work to support the team. During this phase, team members start to trust each other.
- **Performing:** The team starts working as a unit. Team members depend on each other and work through issues easily.
- **Adjourning:** The team completes the project. Team members are released to other projects once the project closes.

In some cases, a team may skip one of these stages. The team may need to return to a previous stage if certain events happen, such as a new team member being added to the team. The project manager is responsible for helping the project team to advance through the team-building stages.



Team Selection and Skill Sets

The project team may be selected by preassignment, negotiation, or acquisition:

- **Preassigned resources:** Personnel assigned to the project from the start, based on position in the organization and/or knowledge and skill sets.
- **Negotiated resources:** Personnel the project manager wants on the project team and must negotiate with other managers to obtain.
- **Acquired resources:** Personnel from outside sources, such as consultants and subcontractors.

No matter how the resources are obtained, the project manager must understand the skill set of each team member. Depending on the skill set, the team member will be assigned to certain activities or tasks within the project. As part of the skill set, the project manager may also need to document the work rate for the team member. For example, knowing how many square feet of brick a bricklayer can lay per hour would help in understanding how long a wall would take to build.

Although not all activities or tasks can be broken down by work rate, team members often can provide the project manager with an estimate of how long a certain task will take to complete. Such estimates are important for making best-guess determinations for the *resource calendar*, which lists all resources and the dates and times when they are available to the project. Because work rates can differ, one person may be able to complete certain work much faster than another person can. The

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project manager must understand and document these details along with the skill set information to determine the best use of personnel resources.

For all personnel resources, the project manager will need to document the following information:

- **Availability:** Indicates when each resource can actually perform work.
- **Cost:** Specifies the rate at which the resource will be paid.
- **Experience:** Documents the resource's work background.
- **Ability:** Records the resource's competencies.
- **Knowledge:** Describes the resource's understanding of customers, similar projects, and the project environment.
- **Attitude:** Documents how the resource feels about the project and team, focusing on whether the person will be able to work well in the team environment.
- **International factors:** Lists the resource's location, time zone, communications capabilities, and any international customs/norms that may not be understood by the other members of the project team.

Documenting all of this information helps the project manager acquire a project team that will be able to work well together toward the project's completion. Once the project team is acquired, the project manager should ensure that the appropriate training is provided to the team members (if needed) and that project team members are assigned to the appropriate activities or tasks.

Remote Versus In-House

The project manager may need to consider both remote and in-house resources when acquiring project team members. Managing a project team that works from the same location is much easier than managing a remote or virtual project team. In either case, however, the project manager must rely on his or her interpersonal skills and productivity tools to help the team work together efficiently.

In a *virtual team*, all or part of the team works remotely. Virtual teams work together to meet the project's goals, but with little or no face-to-face interaction. Today's communications capabilities, including email, conferencing technologies, and social media, can make managing virtual teams easier.

Disadvantages of using virtual teams include communication issues, feeling isolated, collaboration difficulties, and technology costs. The project manager should be aware of these disadvantages and work to help facilitate team communications. Coming up with ways to deal with conflict is also important. Finally, cultural differences may need to be explored if team members are global.



Personnel Removal/Replacement

No matter how well a project manager plans, unexpected issues may arise with personnel, resulting in the need to remove and/or replace project team members. This is one reason why the project manager must fully understand the skill set and work rate of every team member. If a team member is simply removed or replaced, the work allocated to that resource will need to be allocated to another resource. When a team member is removed or replaced, the project manager must adjust the project schedule and budget for this change.

EXAMPLE: A team member who is working on two projects resigns, and replacing that person's skill sets requires two separate resources. Hiring those resources will likely result in higher costs to both projects. However, because two resources are now available, the work rate may actually increase, meaning that the project tasks allocated to these resources will be completed more quickly. So while the budgets for the two projects may increase, the project manager may see an improvement in the project schedules.

The project manager should communicate team member changes to the entire project team and project stakeholders. The project manager should also distribute applicable high-level documents to the appropriate stakeholders after a team member change that will require adjustments to the project budget and schedule.



Communication Issues

Because communication issues may arise between project team members and/or stakeholders, the project manager should provide team members with the communication plan developed during the project's Planning phase. This plan explains how, when, and by whom information about the project will be administered and distributed. Team members should use this plan as a guideline for all communications.

Even if the project has a well-developed communication plan, communication issues may still arise. Many project problems are actually the results of poor communication, which can lead to project issues such as differences in expectations, surprise over project changes, and so on. The project manager must aid team members and stakeholders in resolving such issues.

Because the project manager is ultimately responsible for managing project communication, it is important to understand the following communication issues and ways of handling them:

- **Failure to listen:** Stress to project team members the importance of listening and focusing on the speaker.

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- **Geographical issues:** With geographic distance between team members, strive to hold regular meetings, giving all team members time to communicate their status and any issues requiring help.
- **Cultural differences:** All team members should provide input into the project, even if that means soliciting feedback from the more reluctant members. Any small groups in the team should include team members from diverse cultures.
- **Attitude and ego:** Be aware of strong personalities within the project team. If one team member tries to monopolize meeting time or dictate project policies, the project manager should step in to help the team come to a mutual understanding through negotiation.
- **Authority or hierarchy issues:** Team members may be reluctant to express issues in a group setting, particularly if the group includes individuals with authority. The project manager should spend time with each team member privately so that the team member can express any issues confidentially.
- **Poorly written communication:** Make sure that all communication is clear and concise. Any textual communication created for dissemination should be reviewed by someone other than its author to check for errors or omissions.
- **Gender bias:** All team members, regardless of gender, must have a chance to express their concerns. Team members should never be belittled for their point of view, even if those views are not held by the majority of the team.
- **Focusing or listening problems:** Use team exercises to help team members with listening issues. Group techniques, such as those used by focus groups, may help keep the entire team engaged.
- **Inadequate knowledge:** Make sure that all individuals involved in the project understand all the jargon, acronyms, and other language used by the team. It may be necessary to prepare and distribute a dictionary of terms. In some cases, individuals with inadequate knowledge may need formal training in the area of deficiency.
- **Relationships:** Be aware of any cliques, groups, or friendships within the team's personnel resources, and stress to team members the need to be objective. Relationships can affect decisions and result in *groupthink*—groups making decisions in a way that discourages individual creativity or responsibility.

Ultimately, the project manager is responsible for ensuring that all communication issues are resolved, which may require seeking assistance from people who demonstrate effective communication skills.



Conflict Resolution

Conflict in a project is not a matter of *if* it will happen, but rather *when* it will happen. Common sources of conflict include resource scarcity, scheduling issues, and work style. When conflicts occur, the project manager is responsible for working with team members and stakeholders to resolve the issue, regardless of its source.

Conflict-resolution techniques include smoothing, forcing, compromising, confronting, avoiding, and negotiating. The following sections discuss these techniques in detail.

Smoothing

Smoothing, also known as *accommodating*, emphasizes areas of agreement rather than differences. With this technique, the project manager helps team members to accommodate the concerns of other people. Smoothing may be appropriate in the following circumstances:

- When temporary relief from the conflict or buying time is important
- When the issue is more important to one person than to another
- When one of the parties is wrong
- When continued conflict would be detrimental to the project

In some cases, the project manager may choose smoothing in order to protect interests that are more important, while giving up on some interests that are less important. Smoothing gives team members an opportunity to reassess the situation from a different angle.

Use smoothing only when needed; it should not be the go-to solution for all conflict. Parties in the conflict may try to take advantage of smoothing, and some team members may not like the use of smoothing for conflict resolution. In addition, smoothing may have a negative effect on the team's confidence in the project manager's ability to respond to aggressive conflict situations. Finally, smoothing makes it more difficult to transition to a future *win-win* solution, in which the chosen solution is the one that best satisfies the concerns of both parties.

Forcing

Forcing, also known as *directing* or *competing*, pursues one viewpoint despite the existence of other viewpoints on the team. It often involves resisting another team member's actions. Forcing may be appropriate in the following circumstances:

- When less forceful methods do not work or are ineffective

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- When the team is receiving pressure to pursue a particular viewpoint that the project manager feels is wrong
- When a quick resolution is required and using force is justified
- As a last resort to resolve a long-lasting conflict

Project managers sometimes use forcing to provide a quick resolution to a conflict. Forcing increases respect when firm resistance is a response to aggression or hostility.

Forcing may negatively affect the project manager's relationship with the opponent. In addition, it may cause the opponent to react in the same manner. With this method, the strong points of the other side's position are ignored. Taking this approach requires a lot of energy.

Compromising

With *compromising*, also known as *reconciling*, the team searches for a solution that will bring satisfaction to all parties by partially resolving the conflict. Compromising may be appropriate in the following circumstances:

- When goals are only moderately important and not worth the use of other approaches
- To reach temporary resolution on complex issues
- To reach expedient solutions on important issues
- When the involved parties do not have a high level of mutual trust
- When collaboration or forcing do not work

Compromising is faster than other conflict-resolution techniques and may be practical when time is a factor. It can provide a temporary solution until a win-win solution can be found. Compromising lowers tension levels and stress in conflict situations.

In a *lose-lose* situation, the compromise does not satisfy either party. Unfortunately, compromising does not contribute to building trust and may require monitoring to ensure that agreements made during the compromise are met.

Confronting

With *confronting*, also known as *problem solving*, the team uses multiple viewpoints to lead to consensus. With this method, the team attempts to work together to find a win-win solution to the problem in hand. The goal of this approach is to

find a mutually beneficial result. Confronting may be appropriate in the following circumstances:

- When consensus and commitment are important
- When in a collaborative environment
- When multiple stakeholders' interests need to be addressed
- When a high level of trust is present
- When a long-term relationship is important
- When animosity is involved
- When the team needs to share responsibility

Confronting usually leads to solving the actual problem while reinforcing mutual trust and respect. It also builds a foundation to help bring about effective collaboration in the future. Project managers who use this technique are often seen as good negotiators. This method of conflict resolution usually results in less stress than with most of the other methods.

When confronting a conflict, all parties must be committed to finding a mutually acceptable solution; therefore, this method of conflict resolution requires more effort and time than other methods. Confronting is not practical if time is crucial, because a win-win solution may not be evident. If trust within the team is ever damaged, this method cannot be used until trust is reestablished.

Avoiding

Avoiding, also known as *withdrawing*, postpones the issue until the project manager can be better prepared or other parties can resolve the issue. This technique often involves sidestepping the issue. Avoiding may be appropriate in the following circumstances:

- When the issue is trivial
- When dealing with the issue directly is impractical because time is limited
- When more information is needed to make a decision
- When it is not the right time or place to address the issue
- When unreasonable effort would be required to resolve the issue
- When the discussion could lead to hostility
- When another party needs to be involved

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Avoiding is often used to postpone the decision until more favorable circumstances allow for pushing back from the opposing viewpoint. When the conflict is short-term, withdrawing is a low-stress approach. It gives the team time to focus on more important issues, and it allows the team to collect information before taking action.

Avoiding an issue may weaken relationships with the project team or any parties that expect immediate action. Avoiding also requires skill and experience to prevent negative effects in the project manager's position.

Negotiating

Negotiating brings two viewpoints together to discuss issues and reach a solution. Negotiation skills include setting goals and limits, controlling emotions, listening, verbal communication, and understanding when to close the negotiation.

Project managers use two categories of negotiation:

- **Competitive negotiation:** Concerned with getting the best deal, competitive negotiation is mostly used in contractual negotiations with third parties. Avoid this type of negotiation if possible.
- **Collaborative negotiation:** Seeks a win-win situation, as with confronting. Collaborative negotiation works to build relationships while minimizing conflict.

Negotiation is helpful when the project manager does not have full project authority, such as when the organization has a functional or matrix structure.

NOTE For more on project team structure (projectized, matrix, or functional), see Chapter 2.

Negotiation includes planning, discussing issues, proposing solutions, bargaining for trade-offs, agreeing to a solution, and reviewing the resolution. But watch for these issues with negotiation:

- Failing to prepare properly
- Making an unreasonable offer
- Neglecting to take time-outs in protracted negotiations
- Rushing negotiations
- Failing to walk away
- Failing to remain calm

Project managers may need training in negotiation skills. They must be able to spell out the guidelines to any team members involved in the negotiations.

Key Topic

Resource Management

Resource management ensures that all the supplies needed to complete a project are identified and managed appropriately. During the Planning phase of a project, the project manager must identify all the required resources. If the organization does not own all the necessary resources, any missing resources must be purchased or arranged as part of procurement management. Resources owned by the organization must be scheduled at the appropriate times for use as project resources. Procurements must be managed from planning, conducting, and controlling the procurements through to closing the procurements when the resources are obtained and ready for use. A resource calendar should be developed to show all resources needed by the project and when they will be used.

NOTE In some project management articles, the term *project resources* includes personnel resources such as team members. For all the resource issues discussed in this section, keep in mind that the topic can also apply to personnel resources, but this discussion focuses on non-personnel resources.

Resources vary by project. To compile a comprehensive list of needed resources, the project manager may need to consult with subject matter experts.

EXAMPLE: For a construction project, resources might include equipment and supplies such as heavy machinery, tools, concrete, lumber, paint, and so on. For a project that adds a new subnet to a network, resources could include network devices, wiring, software, etc. No matter what type of project the organization contemplates, determining all the necessary resources in advance is important.

The project manager must have the appropriate skills to manage shared and dedicated resources, including allocating, monitoring, and controlling resources to prevent resource shortages or overallocation; establishing procedures for handling low-quality resources; and documenting benched resources. Finally, the project manager should document interproject dependencies and any resource contention.

Shared Versus Dedicated Resources

When allocating resources to a project, the project manager must understand the difference between shared and dedicated resources:

- **Shared resource:** Used jointly between multiple projects. When using shared resources, the project manager will need to negotiate with department

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managers or other project managers for resource availability. This negotiation may also involve the PMO if one exists. Keep in mind that the type of organization and project team structure (projectized, matrix, or functional) affect resource negotiation.

- **Dedicated resource:** Allocated to a single project. When using dedicated resources, the project manager has full access to the resource for the project.

NOTE Organizational types and project team structures are discussed in Chapter 2.

EXAMPLE: A construction company has two dump trucks to share among three projects. To meet the needs of all three projects, the project manager needs to work with resource managers to schedule the dump trucks. A lower-priority project may have to wait until after a higher-priority project is finished using the equipment. If enough financial resources are available, the organization might rent or purchase additional trucks. The project managers will have to work together to avoid or at least anticipate scheduling conflicts and make other arrangements.

EXAMPLE: An IT project requires access to a lab environment that is shared with another department. It may be possible to grant both the project team and the department personnel concurrent access to the lab environment without causing resource contention. However, if a conflict arises, the project manager will need to work with the department supervisor to adjust schedules to give both the project team and the department personnel time in the lab.

These examples show that projects impacted by resource availability may affect project schedules. For this reason, it is important to identify these resources and document the resource calendar prior to creating the baseline project schedule.

Resource Allocation

With all the necessary resources identified for a project, the project manager needs to list those resources in the resource calendar, showing the availability of each resource to the project. For resources that will be purchased, the project manager must also create the procurement management plan (part of the project management plan) and then monitor all procurements to ensure that they are received as planned.

NOTE Chapter 1, "Project Properties and Phases," describes the procurement management plan and the other parts of the project management plan.

After obtaining or ordering all resources and creating the resource calendar, the project manager can begin *resource allocation*, which is the process of assigning resources to individual project activities or tasks. For example, a plumber and plumbing supplies should be allocated to any plumbing tasks, and an electrician and electrical supplies should be allocated to any electrical wiring tasks.

Resource Shortage Versus Overallocation

A *resource shortage* occurs when a project does not have enough of a particular resource to complete an activity or task, and a *resource overallocation* occurs when the project has too much of a particular resource, resulting in leftover inventory or idle team members. A resource shortage usually affects the project schedule because project activities or tasks cannot proceed until more of the missing resources are available. It also affects the project budget because the resources will have a cost. For example, even if missing parts can be delivered on the same day, thereby preserving the schedule, the project budget will have to stretch to include any delivery costs. A resource overallocation means that more resources were purchased or allocated than needed, usually resulting in wasted budget.

Project managers need to consult with experts and skilled personnel to ensure that appropriate resources are obtained for the project.

EXAMPLE: Based on a building blueprint, electricians should be able to estimate electrical resources needed for a project, such as the amount of wiring. Based on a menu, chefs should be able to estimate the amount of purchased food that will be needed to prepare a banquet.

The project manager cannot expect to make detailed estimates alone. Other individuals should be involved as needed, to ensure that all resource estimates are as accurate as possible.

Low-Quality Resources

A single resource may have several characteristics that influence how the resource as a whole affects other parts of a project. A resource *attribute* is a characteristic that varies between resources.

EXAMPLE: Construction projects often use different grades of lumber and other resources. A lower-grade resource may be fine if the project is constructing outbuildings. But if the project is constructing a commercial building in an earthquake-prone location, the quality of resources used is likely much higher, possibly governed by local, state, and federal regulations. Differences within resource types also may change over time. For example, the project sponsor may want high-quality resources early in the project but later decide to allow low-quality resources when the budget needs to be trimmed.

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If the project has quality requirements for resources, those requirements must be stated explicitly in any contracts for the procurement of those products.

EXAMPLE: A company decides to add a new subnet to its existing network. While the desired network speed may be achievable with Cat 5 cabling, the company might specify a higher category such as Cat 6e or Cat 7 to ensure that the network will not need upgrades in the future because of slow performance. It may even be possible to specify fiber-optic cabling if the project budget is sufficient.

The project manager should consult with experts to ensure that resource specifications include quality requirements that fit within the project guidelines and any governing regulations.

Benched Resources

The term *benched resource* is most commonly used for personnel resources available for a project but not being utilized. However, the same term can refer to any type of available resource that cannot be used for some reason. Benched personnel may experience low morale while spending time "on the bench," whereas other benched resources may occupy space needed by active resources.

Project managers should pay careful attention to scheduling to ensure that resources are not benched for long periods of time. While some reasons for benching a resource may be beyond the control of the project manager, all resources should be utilized in a timely manner. For example, if a team member does not have the skills to complete a certain activity or task, perhaps another activity or task could be split to include that person. This solution might have the added benefit of completing the split task more quickly.

Resource management tools can help project managers to manage resources well and minimize benched resources.

Interproject Dependencies and Resource Contention

Interproject dependencies occur when one project must wait for another project to complete results that are needed by the first project. For example, if project A requires the results of a customer study that is being completed by project B, project A cannot be completed until those results are received.

If multiple projects need to share personnel and other resources, each project must rely on the other projects to release resources in a timely manner for all projects to succeed. When multiple projects require a particular resource at the same time, it causes *resource contention*. The organization must have a method for determining project priority when resource contention occurs.

Depending on the organizational structure, a PMO or department head may have to decide which project gets priority. A variety of factors, including each project's priority, schedule, budget, or other constraints, could help in deciding which project gets the resource first. One project may even have some float time that can accommodate any delay in receiving the needed resource. Some organizations define resource contention guidelines to ensure that all projects follow the same rules when making resource contention decisions.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 5-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 5-2 Key Topics for Chapter 5

Key Topic Element	Description	Page Number
Section; list	Overview of *team building*, *trust building*, and Tuckman ladder phases	89
Section; lists	Project team selection and personnel resources	90
Section; example	Overview of *personnel removal or replacement*	92
Section; list	Project *communication issues* and tips for handling them	92
Sections; lists	Techniques for *conflict resolution*	94
Sections; lists; examples	Discussion of *resource management* (resource allocation, shared vs. dedicated resources, resource contention, etc.)	98

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Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

forming, storming, norming, performing, adjourning, preassigned resources, negotiated resources, acquired resources, resource calendar, virtual team, groupthink, smoothing, win-win, forcing, compromising, lose-lose, confronting, avoiding, negotiating, competitive negotiation, collaborative negotiation, resource management, shared resource, dedicated resource, resource allocation, resource shortage, resource overallocation, attribute, benched resource, interproject dependency, resource contention

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. What is the correct order for the trust-building stages of a project team?
   - **a.** storming, forming, norming, performing, adjourning
   - **b.** storming, forming, performing, norming, adjourning
   - **c.** forming, storming, norming, performing, adjourning
   - **d.** forming, storming, performing, norming, adjourning

2. You are the project manager for a new project. Within the past week, you have obtained the project team and started having daily meetings with the team members. Today, the team started making decisions about the project. Which trust-building stage is the team experiencing?
   - **a.** performing
   - **b.** norming
   - **c.** forming
   - **d.** storming

3. You are the project manager for a new project. Three in-house personnel are assigned to the project. You negotiated for two other in-house personnel with their department supervisor. Finally, two consultants were hired for the project. Which type of resource are the consultants?
   a. negotiated resource
   b. acquired resource
   c. preassigned resource
   d. remote resource

4. Which of the following are disadvantages of using virtual teams? (Choose all that apply.)
   a. communication issues
   b. feeling isolated
   c. collaboration difficulties
   d. technology costs

5. The project team you are managing comes to you with an issue. After hearing both sides of the issue, you realize that one side is clearly wrong. Continued discussion of the issue could be detrimental to the project. Which conflict-resolution technique should you use?
   a. forcing
   b. smoothing
   c. compromising
   d. confronting

6. Recently the project team you are managing experienced conflict over a project issue. Unfortunately, the resolution of the issue resulted in a lose-lose situation. Which type of conflict resolution did you most likely use?
   a. smoothing
   b. forcing
   c. compromising
   d. confronting

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7. While determining the resources needed for your current project, you identify two research servers that your project team will need to use. Unfortunately, another project is currently using the servers. Management decides that both projects will have access to the servers for the duration of the two projects. What type of resource are the servers?
   - **a**. shared resource
   - **b**. low-quality resource
   - **c**. benched resource
   - **d**. dedicated resource

8. After completion of a project to remodel an office space within a larger building, you discover a lot of unused flooring and electrical supplies. What most likely caused this problem?
   - **a**. benched resource
   - **b**. low-quality resource
   - **c**. resource shortage
   - **d**. resource overallocation

9. You are the project manager for a project with several hardware procurements, including a server computer and an uninterruptible power supply (UPS). When your team receives the hardware, they notify you that the UPS cannot handle the required load. What term describes this situation?
   - **a**. low-quality resources
   - **b**. benched resources
   - **c**. resource shortage
   - **d**. resource overallocation

10. Two projects need access to the skills of a particular team member. Unfortunately, based on the project schedules, both projects need the team member for a four-day period during the same week. Project A has three days of float, and project B has 14 days of float. What should you do?
    - **a**. Give priority to project B.
    - **b**. Give priority to project A.
    - **c**. Split access to the resource between the projects, making the tasks take twice as long.
    - **d**. Hire another resource to work on one of the projects.



This chapter covers the following topics:

- **Identify the basic aspects of the Agile methodology:** Adaptive planning, iterative and incremental processes, continuous requirements gathering, user stories, scrum development, continuous feedback, burndown charts, self-organized and self-directed teams.

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Agile Methodology

Agile development is a special way of managing teams and projects. Although Agile is used mostly to manage information technology development projects, this methodology is suitable for any project in which uncertainties exist. The term *Agile* is derived from the *Agile manifesto* (see agilemanifesto.org), which describes four important value comparisons that are as relevant today as they were when the manifesto was published in 2001:

- **Individuals and interactions** over processes and tools
- **Working software** over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

By seeking alternatives to traditional project management, Agile development helps teams respond to unpredictability through incremental, iterative work and feedback.

This chapter covers the following objective for the Project+ exam:

1.7 Identify the basic aspects of the Agile methodology.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 6-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 6-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Adaptive Planning	1
Iterative and Incremental Processes	2
Requirements Gathering and User Stories	3
Scrum Development	4–10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which quality of Agile projects allows a project to meet changing conditions?
   - **a.** incremental
   - **b.** predictive
   - **c.** iterative
   - **d.** adaptive

2. Which of the following statements describes the iterative quality of Agile projects?
   - **a.** It breaks the project into smaller components.
   - **b.** It provides a linear development plan that is structured around the desired result.
   - **c.** Each incomplete area is refined until the result is satisfactory.
   - **d.** Completed work is delivered throughout the project life cycle.

3. What tool is used in Agile planning to help with requirements gathering?
   - **a.** burndown charts
   - **b.** user stories
   - **c.** scrum retrospectives
   - **d.** questionnaires

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4. In Agile projects, what is the purpose of burndown charts?
   a. tracking the completion of tasks for the current sprint
   b. tracking the completion of tasks for the entire project
   c. deciding the specifics about the sprint that the team will be working on
   d. deciding the specifics about the project that the team will be working on

5. What key component is required for an Agile project to succeed?
   a. burndown charts
   b. continuous feedback
   c. scrum master
   d. scrum retrospective

6. Which of the following does *not* occur during sprint planning?
   a. The team uses burndown charts to gather requirements.
   b. The team decides on the sprint duration.
   c. The team selects the target backlog that will be addressed during the sprint.
   d. The team estimates the tasks.

7. Which of the following is *not* one of the questions answered in the daily scrum meetings?
   a. What did the team member do yesterday?
   b. What will the team member do today?
   c. Are any obstacles in the way?
   d. What went wrong during this sprint?

8. During the scrum retrospective, who should document and prioritize actions and lessons learned prior to starting the next sprint?
   a. team member
   b. product owner
   c. scrum master
   d. project manager

9. When should a scrum retrospective be held?
   a. before every sprint
   b. after every sprint
   c. after the last sprint
   d. before the first sprint

10. Which description best fits Agile teams?
   a. centrally organized and directed
   b. self-organized and self-directed
   c. centrally organized but self-directed
   d. self-organized but centrally directed

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Foundation Topics

Adaptive Planning

Key Topic

Predictive planning uses historical data to provide a linear development plan structured around the desired result. For example, the process to build most homes is generally the same: ground preparation, foundation, framing, and so on. Predictive planning works well for these types of projects.

Adaptive planning allows a project to evolve as needed to face changing conditions. By breaking the project into small components created over an undetermined timeline, adaptive planning gives the project flexibility. Results from one project task can cause the project to be changed to adapt to the changing environment.

Predictive projects produce outputs that are expected, whereas adaptive projects can yield surprises. Because adaptive projects are incremental, the end results may differ greatly from the original plan.

Because Agile projects use adaptive planning, project teams must remain flexible and open to change. As a project is completed in stages with a series of deliverables, Agile allows the project's direction to be modified based on the organization's needs. Agile methods tend to lead to improved quality and productivity.

Iterative and Incremental Processes

Key Topic

An *iterative process* makes progress toward the desired result through a sequence of refinements. As the project team makes the first pass through the development steps, they know that the result will be incomplete. As the project progresses, the team will iterate back through each incomplete area and improve it by adding detail and functionality. The end product is refined in stages until the team is satisfied with the result.

EXAMPLE: To understand an iterative approach, think of a sculpture. The sculptor starts with the raw material and carves it into a general shape. The earliest tasks are roughing out the form and removing excess material from all areas of the piece. During the next stages, the sculptor refines the work, adding details to each area that was previously roughed out. However, the sculpture is not finished until the entire work is complete. The sculptor may need to return to certain areas to refine and revise the work before the final product reflects the sculptor's intended design.

An *incremental process* produces usable deliverables at each step of the process, although the results of each step may not resemble the final results.

EXAMPLE: To understand an incremental approach, think of a suburban housing development. The developer hires an architect to produce concept drawings of the homes and plan the lot lines, roads, and utilities for the new community. Once the concept is approved, the architect creates blueprints that can be used to estimate costs and construct the buildings. After the blueprints are final, the developer builds a model home that home buyers can tour during the sales process. When the lots are sold to buyers, the developer constructs the final homes.

An incremental approach does not revisit previous steps in the process. In this example, once the utility lines are installed, the developer would not return to the first step to redraw the lot lines or move the home sites.

Agile development is both iterative and incremental, changing in response to feedback while it is still in process:

- **Iterative:** Agile development is iterative in that the project team plans to improve on the work of one iteration during subsequent iterations.
- **Incremental:** Agile development is incremental in that completed work is delivered throughout the project's life cycle. Constant feedback from stakeholders, users, and the sponsor allows the project team to change the project requirements over time.



Requirements Gathering and User Stories

In an Agile project, constant feedback from the stakeholders is used to refine the project requirements, which may mean that the requirements at the end of the project differ from the requirements at the beginning. Requirements are frequently rewritten as the project's needs change or as new design considerations are revealed.

Project stakeholders in an Agile project are actively engaged in generating *user stories* for new features and requirements. A user story captures software feature descriptions based on a particular user. A user story has three basic parts:

- Who are we building it for?
- What are we building?
- Why are we building it?

To better understand user stories, examine the following user story examples:

- **Editor:** I want to see all my active publications on the main screen.
- **Student:** I want to see all of my old grades on the board.
- **Researcher:** I want to see the last five searches I have done.

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The project team documents requirements based on the user stories:

- **Editor:** Show active publications on the main screen.
- **Student:** Show old grades on the board.
- **Researcher:** Show the last five searches.

By continuing to gather design requirements while project work is underway, the project team can shape the product to meet the customer's needs. Project results are released intermittently to the customer, allowing testers, engineers, and the customer to fully study the design.

Agile teams often use the *story mapping* technique to discover requirements and generate a full map of the project. With this technique, the team maps out user stories to discover the features that the customer needs. As they write user stories, the team gathers requirements. These active discussions help the team to determine the full feature design. Story mapping is effective because it produces active discussion, step visualization, and requirements gathering based on the user stories.



Scrum Development

Scrum is a project management framework that emphasizes teamwork, accountability, and iterative progress toward a well-defined goal. The most popular Agile methodology, scrum is both simple and flexible. The scrum method centers around a repeated, iterative work cycle called a *sprint*. The goal of a sprint is to complete one of the product's requirements in a usable form. Sprints typically start with a sprint planning meeting, cycle through daily scrum meetings, and end with a retrospective meeting.

In the scrum methodology, the *scrum master* handles any outside distractions or internal complications that could prevent the team from making progress on the project. The scrum master helps translate stakeholder needs into requirements and enforces scrum policies while maintaining the team's focus on project design. The scrum master's goal is to keep the team actively moving forward and on track.

Unlike a traditional project manager, a scrum master does not assign work to team members or direct the project's strategy. The *product owner* role handles many of the traditional project management tasks, such as prioritizing the order of work, managing the budget, accepting deliverables, and setting release dates. The product owner is the Agile product's key stakeholder, who provides the overall vision for the product.

While user stories are most often written at the beginning of a sprint, team members may actually create user stories at any time in the cycle. Requirements are

then created from the user stories. Agile development teams maintain a *backlog* as the project progresses. This backlog contains any requirements that are not being addressed in the current sprint. With Agile, the sprint backlog is fed into the project as the development team completes work.

Key Topic

Sprint Planning

Sprint planning is the process that decides the specific work to be handled in the upcoming sprint. The product owner, the scrum master, and the entire project team attend the sprint planning meeting. Other project stakeholders may also be invited to the sprint planning meeting.

During the sprint planning meeting, the team decides on the sprint's duration. The Scrum Alliance (an organization that helps with scrum standards) suggests 30-day sprints, but the duration can be as short as one week. As a guideline, the duration selected for one sprint should be the duration used throughout the project. During the sprint planning meeting, the project team selects the target backlog that will be addressed during this sprint. Once those targets are known, then the team will need to clarify the requirements of this sprint.

The team returns to sprint planning after the end of each sprint, until all the backlog items are completed or removed. Because the team specifies how much work they can do in each sprint, sprints do not necessarily map out to portions of a project. For example, the product owner cannot expect every sprint to get one-quarter of the work done just because that amount was accomplished in the first sprint.

Daily Scrum Meetings

Scrum meetings are typically held in the same location and at the same time each day, usually first thing in the morning. These meetings are strictly timed at 15 minutes. All team members must attend the meetings. The scrum master and product owner should also attend the meetings to show support and note any issues. If other people are allowed to attend the meeting, they should only expect to listen.

Each team member is given time to speak, answering the following questions:

1. What did the team member do yesterday?
2. What will the team member do today?
3. Are any obstacles in the way? If so, what are they?

By answering these three questions, each team member commits to accomplishing certain tasks to help the team reach its sprint goal. Any obstacles raised become the

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responsibility of the scrum master, although the scrum master may enlist someone else's help in removing the obstacle.

Properly held daily scrum meetings help the team share responsibility for the backlog and the burndown chart (discussed later in this chapter). They also help team members to hold each other accountable for achieving their daily obligations.

Continuous Feedback

Agile development requires continuous feedback to ensure project success. Each team member plays an important role in the project and must adapt to new processes. Without continuous feedback, a team member may repeat mistakes. Each team member's actions should be analyzed by the other team members. Timely feedback can help correct a team member to ensure that project objectives are met.

With daily scrum meetings, Agile teams can provide continuous feedback to ensure quick improvement and adaptation. Constructive feedback for a team member should be based on past instances; the giver provides examples of past behavior and suggestions on how the receiver could have better handled the situation. Equally important to the team is feedback about process improvements. Techniques that can be used for exchanging feedback include one-on-one feedback, group feedback, written feedback, and feedback coaching.

In any Agile project, team members should work to cultivate a culture of continuous feedback. Project managers may need to implement exercises that help develop this culture within the team and the organization. As the project progresses, continuous feedback will become a habit among the team members and stakeholders.



Burndown Charts

Burndown charts are the most common sprint-tracking mechanism used in Agile development. A burndown chart shows the amount of effort expended and remaining for the current sprint. To create a burndown chart, you first need to create a task breakdown. Each task must have the associated hours needed for completion, which the team determines during the planning meeting. The task breakdown lists each task, its status, owner, estimated effort (usually in hours), and remaining effort.

The burndown chart is plotted and updated to reflect project progress, assuming that all tasks will be completed within the sprint at a uniform rate. A red line signifies the ideal progress (baseline burn rate), as shown in Figure 6-1. The Y axis represents the total hours in the sprint (in this case, 200 hours), and the X axis represents the sprint dates in the project.

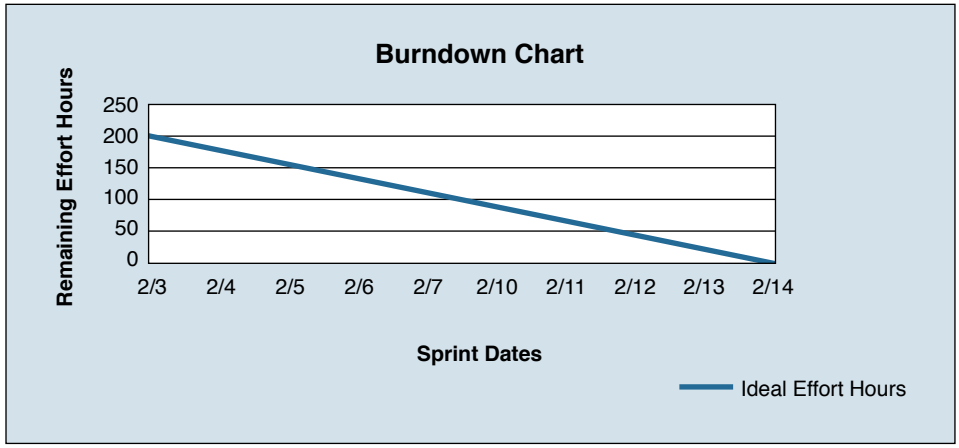


Figure 6-1 Example of a Burndown Chart

As the project progresses, each team member chooses tasks to work on from the task breakdown. At the end of each day, each team member updates the status of the chosen task for that day and estimates the remaining effort needed to complete the task.

The blue line in a burndown chart shows the remaining effort on a daily basis. If the blue line is above the red line, as shown in Figure 6-2, the project is proceeding at a slower pace than projected and may not complete its commitments on time. If the blue line is below the red line, the project is proceeding at an accelerated rate and may finish earlier than expected.

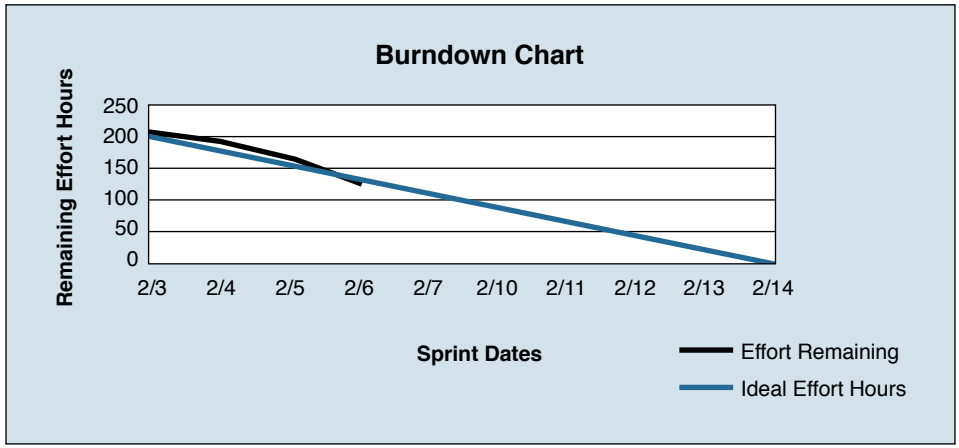


Figure 6-2 Burndown Chart Showing Slow Pace

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In some projects, the burndown chart will end before work is completed. A burndown chart like the one in Figure 6-3 shows that sprint commitments were not met. The remaining work becomes part of the backlog, which is carried forward into subsequent project sprints.

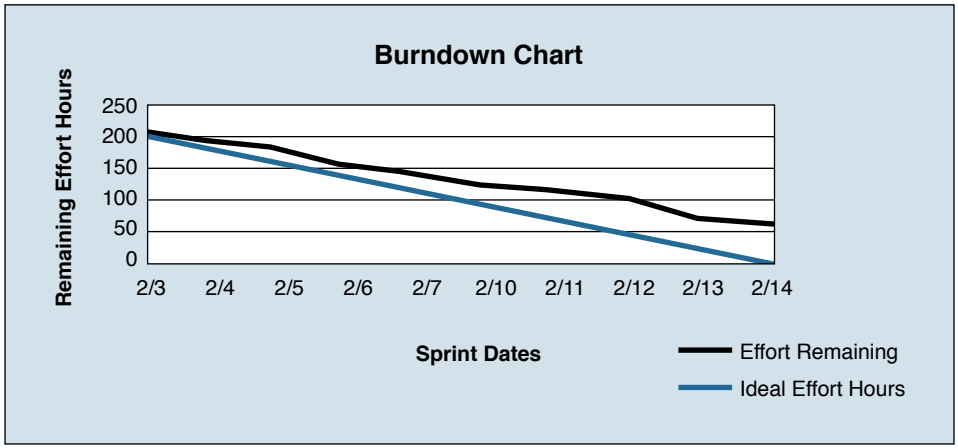


Figure 6-3 Burndown Chart Showing That Sprint Commitments Are Not Being Met

The burndown chart in Figure 6-4 shows that the project team worked at a slower pace during the first few days of the sprint and then pushed at the end of the sprint to meet the commitment. This project team needs to ensure that project tasks are more evenly distributed across sprints and that procrastination does not become a problem.

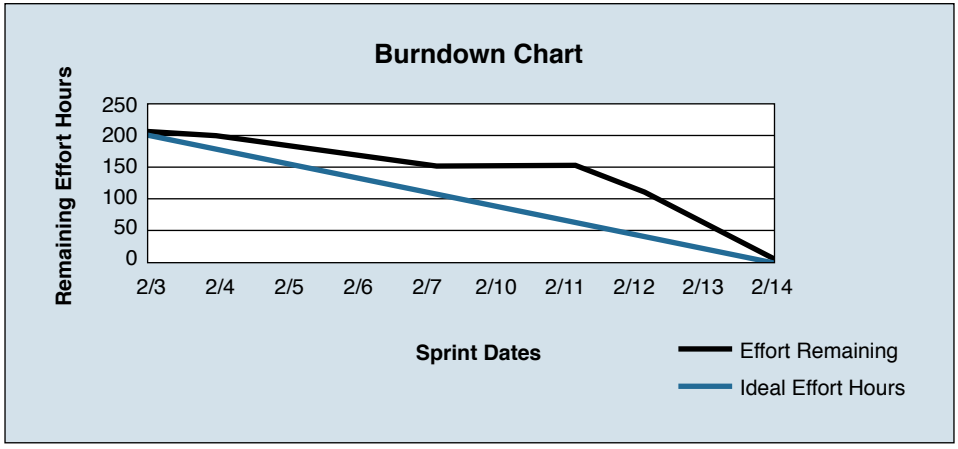


Figure 6-4 Burndown Chart Showing a Push at End of a Sprint

In Figure 6-5, the team's performance has been inconsistent, although it achieved the commitment at the end of the sprint. Most likely this distribution occurred because team members rushed to meet the weekly goals as the end of each week approached.

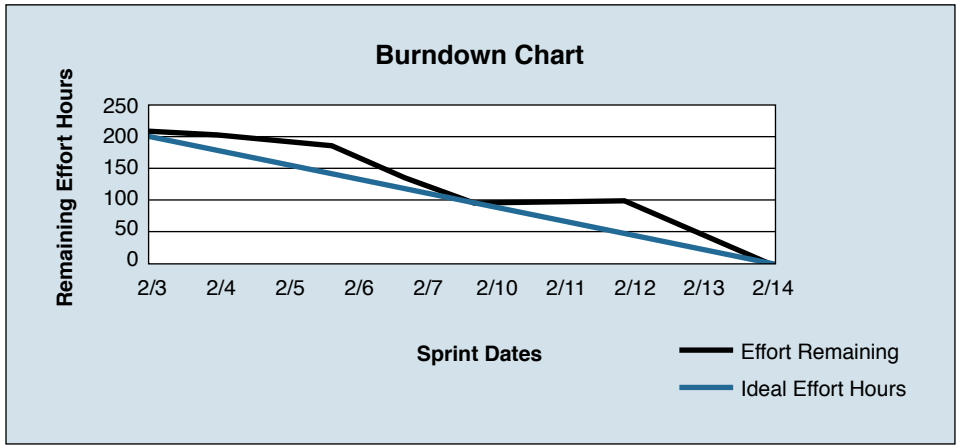


Figure 6-5 Burndown Chart Showing Inconsistent Work

Because burndown charts are so important to project success, the project team should work to ensure that the burndown chart is as accurate as possible. The following are some typical mistakes made on burndown charts:

- **Multiple stories have a common task:** Instead of creating a task in multiple stories, the task breakdown should include a single task that is common across the stories. Then the burndown chart will correctly reflect that the task needs to be completed only once.
- **Tasks are too difficult or too big:** The task size (duration) should be kept to a manageable level to prevent tracking from becoming difficult. Most publications suggest a maximum of 12 hours for a single task.
- **Misunderstanding the relationship between effort remaining and effort spent:** When updating the tasks, team members should re-estimate each task, including updating the effort left to complete. If both fields are not updated, burndown will initially show downward trending. However, the blue line will come back and cross the red line again later in the sprint, as shown in Figure 6-6.
- **Failing to update effort daily:** Task efforts on the burndown chart should be updated by all team members at the end of every day to ensure that the burndown chart shows the correct picture.

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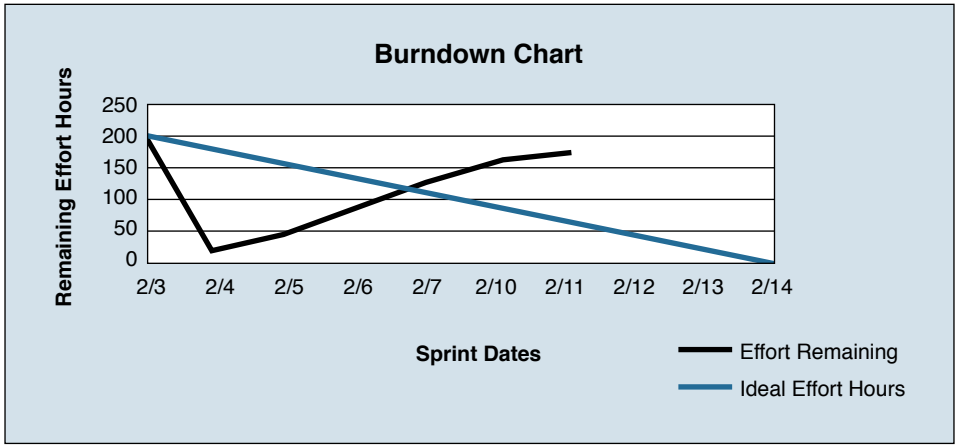


Figure 6-6 Burndown Chart Showing Improper Updating Effort

Tracking progress with a burndown chart offers multiple advantages:

- The project team shares a single planning and tracking tool.
- Daily feedback on effort and schedule provide daily risk mitigation.
- The burndown chart simplifies effective communication with customers and stakeholders.
- Retrospective action items can be tracked effectively.

Scrum Retrospectives

At the end of every sprint, the team holds a *scrum retrospective*. The team members and scrum master meet to discuss the sprint that has just concluded and to note any changes that could help make the next sprint more productive. A scrum retrospective is similar to the "lessons learned" meeting in many project management methodologies.

A scrum retrospective should answer three main questions:

1. What went well during this sprint?
2. What went wrong during this sprint?
3. What changes could be made to improve the next sprint?

At the end of the retrospective, the scrum master should document and prioritize actions and lessons learned prior to starting the next sprint. Keep in mind that the scrum retrospective is all about providing continuous feedback, adapting the project requirements to meet the project's goals.

Self-Organized and Self-Directed Teams

Unlike other project management methodologies that rely heavily on the project manager to guide the team, the project team in an Agile project is expected to be self-organized and self-directed, with each team member responsible to the other team members for his or her obligations. Each team member completes the current obligation and then moves on to another one. In most cases, team members select the tasks they want to achieve, which often allows for completing tasks more efficiently.

A disciplined Agile team is much easier to administer than traditional project teams. In many cases, the scrum master acts more as a facilitator than as a project manager. For this reason, a scrum master still needs the interpersonal skills required by a traditional project manager, in order to help team members respond to feedback and reach consensus on tasks.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 6-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 6-2 Key Topics for Chapter 6

Key Topic Element	Description	Page Number
Section	*Adaptive planning* versus *predictive planning*	111
Section; examples; list	*Iterative process* versus *incremental process*	111
Section; list; examples	*Requirements gathering*, *user stories*, and *story mapping*	112
Section	Overview of *scrum* development: *sprints*, *scrum master* and *product owner*, *backlog*	113
Section	Overview of *sprint planning*	114
Section; Figures 6-1 through 6-6; list	Overview and examples of *burndown charts*	115

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Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

Agile, adaptive planning, predictive planning, iterative process, incremental process, user stories, story mapping, scrum, sprint, scrum master, product owner, backlog, sprint planning, burndown chart, scrum retrospective

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. Which of the following is a valid reason for using Agile versus other project management methods?
   a. Agile uses extensive requirements gathering that includes user stories and questionnaires.
   b. Agile allows the project direction to be modified easily based on the organization's needs.
   c. Agile requires the scrum master to maintain tight control over the project tasks.
   d. Agile specializes in smaller projects that need small teams to complete.

2. Which statement *best* describes what happens with each iteration in an Agile project?
   a. The product is improved.
   b. The schedule is shortened.
   c. The budget is made more accurate.
   d. The schedule is made more accurate.

3. You are the scrum master for an Agile project. You hold a meeting with the project team during which the user stories are written. Which process are you completing?
   a. Holding daily scrum meetings.
   b. Creating burndown charts.
   c. Gathering requirements.
   d. Holding a scrum retrospective.

4. Your project team has developed a burndown chart for an application development project. Who decides the assignment of tasks from this chart?
   a. product owner
   b. project manager
   c. scrum master
   d. team members

5. What does the blue line on a burndown chart indicate?
   a. assignment of tasks to team members
   b. remaining effort on a weekly basis
   c. remaining effort on a daily basis
   d. tasks that remain in the backlog

6. Which condition on a burndown chart indicates that the project is proceeding at an accelerated rate and may finish earlier than expected?
   a. The blue line crosses the red line multiple times.
   b. The blue line and the red line are the same.
   c. The red line is below the blue line.
   d. The blue line is below the red line.

7. Which condition on a burndown chart indicates that the project team is performing inconsistently?
   a. The blue line crosses the red line multiple times.
   b. The blue line and the red line are the same.
   c. The red line is below the blue line.
   d. The blue line is below the red line.

8. You are the scrum master for an Agile project. You need to schedule the sprint planning meeting for this project. Who must attend this meeting? (Choose all that apply.)
   a. team members
   b. product owner
   c. scrum master
   d. stakeholders

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9. During a daily scrum meeting, who should give updates regarding sprint tasks?
   a. the scrum master
   b. a designated team member
   c. all team members
   d. the product owner

10. Your team has just completed the first sprint of a four-sprint project. What must you do prior to starting the next sprint?
   a. Hold a sprint planning meeting.
   b. Create the user stories.
   c. Hold a daily scrum meeting.
   d. Hold a scrum retrospective.



This chapter covers the following topics:

- **Understand the various constraint variables throughout the project:** Constraints include cost, scope, time and scheduling, deliverables, quality, environment, resources, and requirements.
- **Understand the various influences on constraints throughout the project:** Project influences include change requests, scope creep, constraint reprioritization, interaction between constraints, stakeholders/sponsors/management influences, and influences by other projects.

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Project Constraints and Influences

Constraints limit projects in important ways, such as defining the project's scope and available resources. However, constraints are not always fixed in stone; they can be affected by events that occur while the project is underway. Project influences, such as a budget increase or a sponsor's interest in expanding the project, can also require changes to the project's constraints. This chapter examines how constraints—and changes in those constraints—affect the project.

This chapter covers the following objective for the Project+ exam:

2.1 Given a scenario, predict the impact of various constraint variables and influences throughout the project.

NOTE Risks are also considered a project constraint. Chapter 8, "Risk Activities and Strategies," discusses risks in more detail.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 7-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 7-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Common Constraints	1–3, 6–10
Project Influences	4–5

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which constraint is most strongly affected if a project team member will have a higher rate of pay than originally estimated?
   - **a.** quality
   - **b.** time
   - **c.** scope
   - **d.** cost

2. Which of the following project changes would mainly affect the project's scope?
   - **a.** A new requirement for a web application is approved.
   - **b.** A new team member is acquired.
   - **c.** The lab will not be available until next quarter.
   - **d.** The materials needed are only available during the spring season.

3. Which constraint is most strongly affected if a project team member can complete tasks at a faster rate than estimated?
   - **a.** quality
   - **b.** time
   - **c.** scope
   - **d.** cost

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4. Three months into a project, one of the stakeholders wants to add a new feature to the application currently in development. The project sponsor approves this request and expands the project budget. Of which influence is this an example?
   a. triple constraint
   b. constraint reprioritization
   c. scope creep
   d. change request

5. Which of the following is an example of scope creep?
   a. A data center project is $100,000 over budget and six months behind schedule due to the project sponsor's requesting 10 additional server racks.
   b. A company has recently experienced financial troubles and requested project budget cuts that result in a lengthened schedule. When originally started, the project needed to be completed as quickly as possible.
   c. The project sponsor for a new construction project requests that fiber-optic cabling be installed instead of CAT 6 cabling. This request is approved.
   d. A project stakeholder requests that a new clothing line be manufactured using only products made in the United States. This request is approved.

6. During what project phase are constraints first established?
   a. Initiating
   b. Planning
   c. Executing
   d. Monitoring and Controlling

7. If a change to a constraint is necessary, what should the project manager do?
   a. Make appropriate changes in the schedule via the work breakdown structure.
   b. Write the new requirements into the communication plan.
   c. Obtain approval from the project sponsor via the change control process.
   d. Document the changes in the transition/integration plan.

8. Which factors are referred to as the *triple constraint*?
   a. scope, time, cost
   b. resources, time, scope
   c. time, requirements, quality
   d. cost, resources, quality

9. Which of the following does *not* describe a project constraint?
   a. If your organization's product is not released within five months, a major competitor will be first to market with a similar product.
   b. The project must include on-site training for the customer's staff, to be delivered three weeks in advance of project closure.
   c. The materials cost cannot exceed 10% of the budget.
   d. The product must run on the customer's existing point-of-sale terminals.

10. Which of the following describes an interaction between constraints?
    a. The sponsor wants to increase the budget and use a more expensive material. The sponsor asks the project manager to assess the impact of these changes on the timeline.
    b. A newly passed regulation requires an ongoing project to meet additional safety standards. The project manager allocates another month for testing and reschedules the prototype approval meeting.
    c. Because project B has a higher business priority, a senior manager requests that a key resource spend 70% of his time on project B and only 30% on project A.
    d. A team member submits a brochure to the client for approval. The client asks the team member to digitally retouch the executive staff's headshots before printing the brochure.

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Foundation Topics

Common Constraints

Key Topic

A *constraint* is a factor that limits the scope or execution of a project. Constraints are first established during the Initiating phase of the project and documented at a high level in the project charter. During the Planning phase, constraints are documented for the project's scope statement. The project manager must ensure that all constraints are properly documented and monitored.

NOTE The scope statement is described in Chapter 1, "Project Properties and Phases."

If a change in a constraint is necessary, the project manager will need to obtain approval from the project sponsor. The project's change control process outlines how these changes should be approved and documented. The project manager is responsible for evaluating the impact of the change, updating any project documents affected by the change, and communicating the change to the appropriate team members and stakeholders.

NOTE For details on the change control process, see Chapter 11, "Change Control."

This section covers how to predict the impact of various constraint variables, including cost, scope, time and scheduling, deliverables, quality, environment, resources, and requirements.

Together, cost, scope, and time form the *triple constraint*. Altering one aspect of the triple constraint automatically affects the other aspects. Each constraint will have advocates. For example, the project sponsor might mainly be concerned with cost (getting the project result as inexpensively as possible), while the project's customer is mainly concerned with time (getting the project result as quickly as possible) and scope (getting all the necessary features in the project).

All three aspects of the triple constraint have equal weight when a project starts. As the project is initiated and planned, the constraints must be balanced to ensure that the project result is achieved within the scope, time, and cost constraints defined for the project.

Project managers should understand this rule: "Good, fast, cheap—pick any two." Achieving all three goals is impossible. In most projects, one or two constraints will have priority. If constraints are reprioritized during the project, a thorough review of the other constraints must be performed.

EXAMPLE: You are managing a project in which the main concern during the Planning phase was the project's cost. To reduce costs, the project schedule was lengthened, the materials are of lower quality, resources are less knowledgeable, and the scope does not include all the features that were originally proposed. Halfway through your project, a rival company starts work on a competing product. If your project's sponsor wants to beat your rival to market, your project's constraints will have to be reprioritized: Speeding up the schedule would result in higher costs, achieving the needed release date might require further reducing the project scope, and so on.



Cost Constraint

Budget is the classic constraint for any project, because every project has a limited amount of money available. During the Planning phase, the project manager estimates the amount of money that will be required to complete the project. Costs include resources, labor rates for contractors, risk estimates, materials, and so on. All aspects of the project that have a monetary component are part of the overall cost structure. The project manager uses all these cost details to estimate the project budget. Most projects include *reserves*, which are monies that are allocated to deal with risks. Even with reserves, however, only a finite amount of money is available for any project.

NOTE Chapter 8 discusses the different types of risk reserves.

If a project's cost estimates were inaccurate and more money is ultimately required, either the project budget will need to be increased and approved by the project sponsor, or some other project constraint(s) will need to be adjusted. The project's change control process outlines how these changes should be approved and documented.

EXAMPLE: While a project for building a new house is underway, the project manager learns that the lumber costs are significantly higher than projected. The project manager will need to meet with the project sponsor—in this case, the homeowner—to a) obtain additional funds to cover the increased costs, b) decrease costs in other areas, or c) both. Perhaps the homeowner will decide to cut costs in other areas to offset the increase in lumber prices. For example, switching to

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cheaper light fixtures and omitting crown molding might provide enough money to cover the increased cost of the lumber.

Key Topic

Scope Constraint

Scope is a constraint because it restricts work on the project to only what is required to produce the project's final product, result, or service. During the Planning phase, the project manager determines the project requirements that help define the project scope. All requirements that are accepted provide guidance for the project scope.

Because scope combines with cost and time in the triple constraint, a change in scope alters one or both of the other aspects. If the project scope must change, the project budget will need to be changed and approved by the project sponsor, and/or the project schedule will need to be adjusted.

EXAMPLE: During a project for a new banking application, the project sponsor requests an additional feature. The project manager will need to meet with the project sponsor to a) obtain additional funds to cover the new feature and adjust the schedule to account for development, b) decide which other feature(s) can be sacrificed to offset the budget and schedule changes, or c) both. When the decisions are made, the project will need to be adjusted based on those decisions.

Key Topic

Time and Scheduling Constraints

Time is a project constraint because every project has a limited amount of time available to create the project's deliverables. The available time determines the project schedule, which is the time available to deliver a project. Time affects most other project constraints, including cost, scope, quality, and scheduling.

During the Planning phase, the project manager determines the project schedule, assigning all resources to project tasks or activities. The project schedule is based on the amount of time needed to complete the tasks and the amount of time all resources are available. The minimum amount of time required to complete the project (the critical path) also affects the minimum project budget for paid resource hours.

NOTE For a discussion of the critical path, see Chapter 4, "Project Schedules."

If the allotted time for a task is overrun, additional costs will be incurred as additional resources become necessary; for example, staff may need to be paid overtime to complete tasks that exceed the allotted hours. Other project constraints, including quality and scope, may be impacted if additional resource time cannot be obtained.

EXAMPLE: During a project for a new mobile application, the developers indicate that tasks are taking longer to complete than originally projected. The project manager may need to obtain additional staff to help the project stay on schedule, or she might ask current developers to work overtime to meet the original project release date. Either of these choices will result in higher project costs, which affect the project budget. The project manager could also ask for a reduction in the project scope, perhaps by omitting a feature from the application.



Deliverables Constraint

Deliverables are considered project constraints because every project creates some sort of deliverables. These deliverables are considered part of the project scope. Deliverables are also constraints because they must meet specific, measurable benchmarks or key performance indicators (KPIs) to be accepted.

NOTE For more on key performance indicators, see Chapter 12, "Project Management Tools."

During the Planning phase, the project manager determines the project deliverables. If the scope of the project changes after planning is complete, the deliverables from the project are usually affected. If the number of deliverables increases, for instance, the project budget and schedule are usually affected.

EXAMPLE: A new book project is underway, and the author decides to add a chapter to the planned outline. The project manager will probably need to adjust the project schedule to include time for writing the new chapter. The project manager might try to work with the author to ensure that the project schedule remains unchanged, but this option may be unlikely with only one author. Hiring another author would result in higher costs.

While deliverables are not part of the triple constraint, changing deliverables in any type of project definitely affects the project scope and may also affect cost and time.



Quality Constraint

Every project has quality parameters with which the deliverables must comply. The quality constraint is considered part of the project scope, defining the quality of the project deliverables based on the requirements documented in the requirements management plan. Requirements describe the desired outcome, but quality is how to measure whether that outcome is delivered.

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NOTE Chapter 12 covers tools for measuring the quality of deliverables.

During the Planning phase, the project manager determines the project quality. The project scope affects project quality, and quality in turn affects other project constraints. For instance, if deliverables must be made from an expensive material to meet quality standards, the materials cost will be part of the minimum project budget, making it a priority constraint. If producing a correct deliverable takes a lot of time, sufficient resource hours must be scheduled.

Quality changes in any kind of project affect the project scope, and therefore affect the cost (project budget) and time (project schedule).

EXAMPLE: A company is creating a new machine part, and the project sponsor requests changing to a higher-quality metal alloy for the project. The project manager will need to increase the project budget to account for this more expensive material. In addition, the project schedule may be delayed by the time needed to order and receive the new alloy.



Environment Constraint

The environment in which the project takes place can constrain its scope, the quality of its deliverables, the availability of resources, its schedule, or numerous other factors. Environmental constraints include the corporate environment, the global environment outside the organization, and the project environment itself. Project managers must understand and document any effects these environments may have on the project.

The *corporate environment* includes the type of organization and the organization's culture. For example, in a functional company, project managers must work with functional managers to negotiate resource time. This type of environment would constrain resources and scheduling.

NOTE Functional team structure is discussed in Chapter 2, "Project Roles, Responsibilities, and Team Structures."

The *global environment* is the backdrop that sets the stage for the project, such as the regulatory environment, the physical environment (the natural world), the political environment, and/or the fiscal environment. These issues may vary depending on where the project is being completed. For example, a project to design a new car would be constrained by the regulatory environment (safety tests and emission

standards). A construction project is constrained by regulations (building codes) and the building's physical environment (such as a need for earthquake-proof framing). A solar power project might be constrained by the physical environment (sun availability) and the political environment (located in a market with energy tax incentives).

EXAMPLE: A new building project is underway, and the city planning commission reports that the original plans overlap a neighboring property line by six inches. The project manager may need to have the site re-surveyed and work with the architect and designers to adjust the building plans. In addition, the project schedule may need to be adjusted to account for construction delays. Alternatively, the project manager could petition the city to obtain the neighboring property if it is available on the market and affordable.

The *project environment* includes any variables that must be present to complete the project. Some projects may need a "clean room" to carry out scientific experiments. Other projects might require specific environmental conditions, such as temperatures maintained within a certain range. Still other projects may require access to certain physical environments, such as the ocean or outer space. In many cases, these specific conditions can only be obtained at a certain time of year or in a certain location. It is the project manager's job to ensure that the project planning specifies these requirements.

EXAMPLE: A new project is designed to test whether a certain plant can grow in a certain temperate environment during a certain season. For this project, proper planning is essential to ensure that the project is ready to start where and when the season starts.

Changes to the project environment can affect all three triple constraints: scope, time, and cost.



Resources Constraint

Resources are the personnel and other assets needed to complete the project. Personnel might constrain the project by being available only at certain times, needing a fixed amount of time to perform a task, or lacking the skills to produce the deliverables. For personnel resources, the project manager will need to ensure that the team members have the appropriate skills needed to complete their project tasks. For all other assets, the project manager must ensure that the assets are procured and available in time to be used in the tasks for which they are needed.

EXAMPLE: After the Planning phase of a new project is complete, the project manager discovers that the limestone required for the project will not be available from the supplier for at least six months. Another supplier has enough of the limestone in stock for the project, but at a considerably higher price. The project

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manager and project sponsor will need to make a choice between three alternatives: 1) Change the schedule to reflect the projected availability of the required limestone at the original cost. 2) Increase the budget to cover the inflated cost of the limestone that is available now. 3) Change the scope of the project to allow for using another building material.

During the Planning phase of the project, the project manager determines all resources needed for the project. In the Executing phase, the resources must be acquired and allocated to their tasks. The project tasks directly affect the resources needed.

EXAMPLE: In a current printing project, the project sponsor wants to change to using a higher-quality paper. The project manager will need to increase the project budget to account for the increased cost of the higher-quality paper. In addition, the project schedule might be delayed to accommodate ordering and receiving the new paper.

EXAMPLE: A team member resigns, and the project manager must find a replacement. The project manager may need to increase the budget if the replacement team member is paid at a higher rate than that of the original team member. The project schedule also may need adjustment if the replacement team member works at a different speed than the original team member, because the new team member may take a longer or shorter time to complete assigned tasks.

Project resource changes most likely affect time and cost.



Requirements Constraint

Requirements are conditions that must be present in the project's end product or service. Requirements are also constraints because they directly affect the project scope and determine the criteria by which the final product is graded. As stated earlier, requirements describe the desired outcome, but quality is how you measure whether you have delivered the outcome. Requirements are assessed using key performance indicators and acceptance criteria.

NOTE See Chapter 12 for details on assessing requirements with KPIs.

During the Planning phase, the project manager gathers requirements from the project sponsor and stakeholders, documents the requirements, and then negotiates with the project sponsor to determine which requirements will be included in the project. In an Agile framework, this phase includes gathering user stories. The requirements are then used to define the project scope. If the requirements change, the project scope must be changed. In addition, it may be necessary to change the

project budget and project schedule. In some cases, requirements are not attainable at all, or must be delayed until a future revision of the product.

NOTE For more on development with an Agile team, see Chapter 6, "Agile Methodology."

EXAMPLE: A state governmental agency specifies several requirements during an inspection of a construction project. The project manager will need to change the scope of the project to include these requirements, add any necessary tasks to the project to handle the requirements, and allocate resources for those tasks. Finally, the project manager will need to adjust the project budget to include any new costs incurred to meet the requirements.

Project requirement changes usually affect the project's scope, time, and cost.

Key Topic

Project Influences

An *influence* is a project event or condition that can affect a project constraint. Project managers must be able to recognize whether an influence is about to occur, taking appropriate actions to either prevent the influence or adjust the project constraints to account for the influence. Common influences include change requests, scope creep, constraint reprioritization, interaction between constraints, stakeholders/sponsors/management, and other projects.

Key Topic

Change Requests

A *change request* is a formal proposal to modify a project in some way. Change requests include changes to deliverables, baselines, procedures, or documents. No matter which aspect of the project is changed, any approved changes will affect at least one of the triple constraints.

All change requests must be submitted to the change control board and undergo the formal change control process. The change control board reviews the change and decides whether to accept or deny it. Prior to approving a change request, the change control board should thoroughly analyze any project changes that will be necessary to accommodate the change. If the change request is approved, the project manager will then need to change the project scope, budget, and/or schedule to address the approved change.

NOTE The change control process is discussed in detail in Chapter 11.

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EXAMPLE: During a kitchen remodeling project, the homeowner decides he wants to install granite instead of laminate countertops. Because the homeowner is the project sponsor, the project manager will need to explain how the proposed change in countertop materials will affect the project schedule and the budget. If the homeowner approves these time and budgetary changes, the project manager will need to take the necessary steps to implement the approved changes, including ordering the granite, canceling the laminate, renting a granite saw, rescheduling the painters, giving the homeowner a new move-in date, and billing for the difference in materials and labor costs.

Change requests usually affect all three triple constraints: scope, time, and cost. Regardless of the type of project, project managers need to fully analyze any changes to determine ways to offset these changes. For example, counterbalances to a change in project cost could include decreases in scope, time, quality, and/or resources. The project sponsor is best able to determine the changes that should occur if project cost is affected.



Scope Creep

Scope creep occurs when the project scope is changed without adjusting other project constraints, including cost, time, and resources. In most cases, this type of event occurs when the project's scope and requirements are not properly documented during the Planning phase, and it tends to be more likely in larger projects. Think of scope creep as project changes that skip the formal change control process and therefore affect the project constraints without approved adjustments being made.

EXAMPLE: An application development project is affected by a newly enacted government regulation. Unfortunately, the required changes were added to the project requirements without also adjusting the corresponding project constraints, including scope, schedule, and budget. These changes result in the project taking longer than originally projected, and at a higher cost.

Scope creep affects all three triple constraints: scope, time, and cost. Besides documenting the project's initial requirements, the best way to prevent scope creep from affecting the bottom line is to have—and follow!—the change management plan and communication plan described in Chapter 1.

NOTE Aspects of project change and the change control process are discussed in detail in Chapter 11.

Scope creep occurs when clients change their minds and are able to make project changes without going through the change control process. It can be a major

problem when a project has team members who work autonomously. The project manager must ensure that team members understand that *all* changes, large or small, must follow the change control process. Scope creep can happen in any project but is particularly a problem when project team members work from different locations.

EXAMPLE: ABC Corporation hires Designs for You, LLC to redesign the ABC Corporation website. Designs for You, LLC contracts with Jane Smith to code the site and David Jones to design the graphics. Jane and David only interact during virtual project meetings. One month into the project, management at ABC Corporation decides that a graphic for one of the new pages is unsatisfactory, even though it is exactly what the contract specified. ABC Corporation contacts David Jones about the graphic, and David implements the change as requested. However, the change was not formally approved based on the change control process documented in the change management plan. When David's work is complete, he bills Designs for You, LLC for all of his work, including the graphics change. The project manager at Designs for You, LLC adjusts the budget to cover the extra pay for David. When the finished graphics are delivered to Jane Smith, she discovers that the graphics change causes a functionality issue with her code. Jane will now need to adjust her coding, resulting in another budget increase to cover her work. If the higher costs for both workers exceed the budget reserves, Designs by You, LLC will need to either 1) absorb the budget overage, or 2) work with ABC Corporation to increase the budget. This late in the project, a budget increase is unlikely to be approved. To prevent this scope creep, which includes unauthorized graphics and coding changes, the project manager should have explained to all team members that *all* changes must go through the formal change control process, even if the change request comes directly from the project sponsor or customer.



Constraint Reprioritization

Constraint reprioritization occurs when a project that is limited by a particular constraint must shift priorities to another constraint. When reprioritization occurs, the project manager must fully assess all project constraints to document any effects on them. The project manager will then need to explain to the project sponsor what this reprioritization will do to the project.

If a project's cost estimates were inaccurate and more money is required to produce a deliverable, cost becomes the primary constraint for the project. To meet the original scope, the project budget will need to be increased and approved by the project sponsor. If the budget is not increased, another project constraint will need to be adjusted to reduce the pressure of the cost constraint; the project might need to drop a requirement or change the quality standards.

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EXAMPLE: While a publisher is working on a new book project, a competitor announces plans to publish a book on a similar topic with an earlier release date. Because the project's original priority was minimizing costs, only a single author and editor were engaged. However, the publisher now wants to move up the book's schedule to beat its competitor's book to publication. To make the date, the publisher may need to increase the budget to employ additional resources or to give the current resources an incentive to speed up their work. Another option would be to change the scope of the book, perhaps by shortening the content. However, this change probably would also affect quality. No matter which choice is made, the project manager will have to adjust all of the affected project constraints.

Constraint reprioritization affects all three triple constraints—scope, time, and cost—and the ultimate effects depend on which constraint is being prioritized.

Key Topic

Interaction Between Constraints

Project constraints directly interact with each other throughout the life cycle of the project. During the Planning phase, the project manager uses the information gathered about constraints to create the project documents, budget, schedule, and scope.

It is important to realize that other constraints can actually affect one or more of the triple constraints (scope, time, and cost). Resources directly affect project costs. Quality, requirements, and deliverables directly affect project scope. Environment directly affects project time and costs. Results of such changes can be both negative and positive. Suppose two new team members are brought into an engine development project. While this staffing change will likely increase the project budget, it also has a good chance of shortening the project schedule.

EXAMPLE: A key project team member goes on medical leave halfway through a project. The project manager assesses the impact to the project schedule and then presents the sponsor or key stakeholder with possible courses of action. Suggestions might include securing more funding to hire another team member, or extending the project schedule to account for slower progress. The two options affect the project's constraints in different ways:

- If the project will remain understaffed but the schedule can be extended, the project manager will have to reassign the missing team member's work to other resources and adjust the task start/finish dates, dependencies, and critical paths. Project milestones will have to be rescheduled.
- If the original schedule must be followed but more funds will be made available, the project manager should assess the cost to hire new resources, the impact on the schedule if resources must be trained, and the impact on deliverable quality if a sufficiently skilled resource cannot be hired.

Project managers need to understand the relationships between all the constraints, adjusting project scope, budget, or schedule accordingly when other constraints change.

Key Topic

Stakeholder, Sponsor, and Management Influences

Stakeholders, sponsors, and management can also affect project constraints. Stakeholders and sponsors are involved in setting project requirements, which directly affect the project scope. Sponsors also establish the project budget and influence the project schedule.

Management usually affects the project schedule more than the other constraints, especially if the organization's structure is functional rather than projectized. In a functional team structure, the managers control access to the project team members.

NOTE For differences between functional and projectized team structures, see Chapter 2.

EXAMPLE: A key stakeholder asks the project manager to make a significant change in a deliverable. The stakeholder did not consult the project sponsor about this request. The project manager asks the stakeholder to complete a change request that documents the proposed revision and assesses the impact of the change. Only then should the project manager approach the sponsor to seek approval, following the change control procedure detailed in the change management plan.

As with other influences, stakeholders, sponsors, and management can affect all three triple constraints: scope, time, and cost.

Influence by Other Projects

Other projects can influence project constraints; for example, by competing for the use of shared resources. The project manager may need to negotiate with other project managers and with the project management office (PMO), if one is available, to obtain the resources when needed.

EXAMPLE: Two projects need access to the same laboratory as part of the research portion of each project. During project planning, the project management office discovers that the two projects have planned to use the laboratory during the same two-week period. The PMO works with the project managers of the two projects to come up with three options: 1) finding a way to share the laboratory at the same time; 2) allowing each team half-day access to the laboratory, with one project team having mornings and the other having afternoons; or 3) giving primary laboratory

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access to the higher-priority project and delaying laboratory access until later for the lower-priority project. The first two choices would require a schedule adjustment for both projects, and the third choice would require a schedule adjustment for only one of the projects. After fully assessing the options and reaching a decision on how to proceed, the project managers can make the necessary adjustments. In this case, it is not necessary to follow the change control process because the issue was discovered during the Planning phase, prior to project execution.

During the Planning phase, project managers should document any resources that will be shared with other projects. Inter-project conflicts should be negotiated between the project managers. If they are unable to resolve a problem, the PMO or upper management should make the decision. In larger corporations, company policies may dictate how such issues will be resolved.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 7-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 7-2 Key Topics for Chapter 7

Key Topic Element	Description	Page Number
Section; example	Discussion and example of project *constraints* and the *triple constraint*	129
Section; example	Discussion and example of *cost constraint*	130
Section; example	Discussion and example of *scope constraint*	131
Section; example	Discussion and example of *time* and *scheduling constraints*	131
Section; example	Discussion and example of *deliverables constraint*	132
Section; example	Discussion and example of *quality constraint*	132
Section; examples	Discussion and example of *environment constraint*, *corporate environment*, *global environment*, and *project environment*	133

Key Topic Element	Description	Page Number
Section; examples	Discussion and examples of *resources constraint*	134
Section; example	Discussion and example of *requirements constraint*	135
Section	Definition of *project influence*	136
Section; example	Discussion and example of *change request* influence on project constraints	136
Section; examples	Discussion and examples of *scope creep*	137
Section; example	Discussion and example of *constraint reprioritization*	138
Section; example	Discussion and example of interaction between constraints	139
Section; example	Discussion of stakeholder, sponsor, and management influences on project constraints	140

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

constraint, triple constraint, reserves, corporate environment, global environment, project environment, resources, influence, change request, scope creep, constraint reprioritization

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. You have been hired to take over as project manager for a research project. You discover that the costs for the project's supplies are significantly higher than originally estimated. However, the budget was not adjusted to show this increase. What could you do to resolve this issue? (Choose all that apply.)
   a. Request additional funds from the project sponsor.
   b. Find ways to cut costs in other areas of the project.
   c. Decrease the quality of the project.
   d. Shorten the project schedule to decrease costs.

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2. During project planning, the project sponsor for a new electronic device requests that you add a new feature to the product. You meet with the sponsor to discuss adding this new feature. What should be the outcome of this meeting?
   a. Decrease the quality of the new device.
   b. Hire new personnel to develop the new feature.
   c. Obtain additional funds to cover the new feature development.
   d. Remove one of the other features of the device.

3. For your company's current project, the project manager discovers that creating the project deliverables is taking significantly longer than estimated. After discussing this issue with the project sponsor and following the proper change control procedure, the project manager hires a new team member. Which project constraints should be adjusted as a result of this action?
   a. cost, time, and scope
   b. time and scope
   c. cost and scope
   d. cost and time

4. You are hired to take over a project, and you discover that a deliverable was omitted. You discuss this issue with the project sponsor, who decides to add the deliverable. Which project constraints should be adjusted as a result of this action?
   a. cost, time, and scope
   b. time and scope
   c. cost and scope
   d. cost and time

5. For a new printing project, the project sponsor requests a higher-quality vinyl, which is not currently in stock. Which project constraints should be adjusted as a result of this request?
   a. cost, time, and scope
   b. time and scope
   c. cost and scope
   d. cost and time

6. You are the project manager for an application development project. As part of the project, quality assurance testers will need access to a lab environment. After completing project planning, you discover that the lab will not be available when you need it but will be available at a different time. Which project constraint should be adjusted as a result of this issue?

   a. scope
   b. time
   c. cost
   d. requirements

7. You are the project manager for a new construction project. During project planning, you learn that a backhoe owned by the project sponsor can be used for the project. However, two days before you need the backhoe, you find out that it is being repaired, and you must rent a backhoe instead. Which project constraint should be adjusted as a result of this issue?

   a. scope
   b. time
   c. cost
   d. deliverable

8. You are the project manager for a retail store redesign project. Two weeks into project execution, the project sponsor requests that you increase the width of the main aisles by one foot. This change is approved, and the project requirements are adjusted. Of which influence is this an example?

   a. change request
   b. scope creep
   c. constraint reprioritization
   d. another project

9. You are hired to take over as project manager for an existing project. On your first day, you discover that the project is over budget and behind schedule as a result of new requirements having been added to the project. The project's budget and schedule were not adjusted when these requirements were added. Of which influence is this an example?

   a. change request
   b. scope creep
   c. constraint reprioritization
   d. another project

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10. You are managing a project to produce a new refrigerator design for commercial usage. When the project was originally planned, the project sponsor wanted to obtain the design as quickly as possible to be first to market. However, today you learned that the company is having a budget crisis, and the project sponsor asks you to adjust your project to minimize costs. Of which influence is this an example?

a. change request

b. scope creep

c. constraint reprioritization

d. another project



This chapter covers the following topics:

- **Understand risk activities:** Risk activities include risk planning, risk identification, risk quantification and prioritization, risk review, risk response, developing and maintaining the risk register, and risk communication.
- **Understand risk strategies:** Risk strategies include accepting risk, mitigating risk, transferring risk, avoiding risk, exploiting risk, enhancing risk, and sharing risk.

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CHAPTER 8

Risk Activities and Strategies

A *risk* is any uncertain event that may have a positive or negative effect on the project's objectives or other aspects of the project, such as the project cost, scope, or schedule. Risks have both causes and impacts. Risk *causes* are conditions or events that led up to the risk, and *impacts* are the effects that the risk will have on the project. While risk is inevitable, it is not inherently bad—another term for a positive risk is *opportunity*.

Project risk management includes risk management planning, identifying and analyzing risks, planning responses to the identified risks, and controlling risks. Risks must be identified during the Planning phase of a project in order to determine the organization's risk appetite and risk tolerance. *Risk appetite* is the amount of uncertainty the organization is willing to take on in hope of a reward. *Risk tolerance* is the amount of risk that an organization can withstand.

Risk activities are the actions taken during a project to identify, analyze, plan for, and monitor risks. Risk strategies are the methods that an organization will use to deal with risks as they arise. This chapter focuses on risk activities first; risk strategies really cannot be determined and applied until other risk activities are complete.

This chapter covers the following objective for the Project+ exam:

2.2 Explain the importance of risk strategies and activities.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own

assessment of your knowledge of the topics, read the entire chapter. Table 8-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 8-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Risk Activities	1–6
Risk Strategies	7–10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. What is the overall process that identifies, quantifies, and reviews risks?
   - **a.** risk identification
   - **b.** risk register
   - **c.** risk planning
   - **d.** risk quantification

2. Which process creates the first version of the risk register?
   - **a.** risk planning
   - **b.** risk identification
   - **c.** risk review
   - **d.** risk response

3. Which process involves assigning numerical values to the identified risks?
   - **a.** risk identification
   - **b.** risk prioritization
   - **c.** qualitative risk analysis
   - **d.** quantitative risk analysis

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4. What is the main benefit of risk review?
   a. identifying new risks
   b. quantifying new risks
   c. prioritizing new risks
   d. communicating with stakeholders regarding risks

5. What is another term for negative risks?
   a. enhancements
   b. vulnerabilities
   c. threats
   d. opportunities

6. Which document lists all known risks and gives details about each risk?
   a. risk review
   b. project management plan
   c. risk management plan
   d. risk register

7. Which of the following is a risk strategy for positive risks?
   a. risk mitigation
   b. risk exploitation
   c. risk transference
   d. risk avoidance

8. Which of the following is a risk strategy for *both* positive and negative risks?
   a. risk acceptance
   b. risk enhancement
   c. risk mitigation
   d. risk exploitation

9. What is the most common form of risk transference?
   a. hiring more resources
   b. completing all work with outsourced resources
   c. purchasing insurance
   d. implementing redundancy

10. Which strategy for positive risk uses key drivers to ensure that the risk occurs?

a. risk enhancement

b. risk acceptance

c. risk exploitation

d. risk sharing

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Foundation Topics



Risk Activities

Risk activities include planning risk management, identifying risks, performing risk analysis, planning risk responses, and reviewing and controlling risks. These risk activities occur during the Planning phase and the Monitoring and Controlling phase of a project. Because known risks are identified and analyzed, it is possible to plan for those risks. But unknown risks also may exist; such risks cannot be addressed until they occur, because they were not identified during the planning process.

TIP Risk management is the entire strategy for discovering, quantifying, and coping with risk across the project. Individual risks that have been identified are further analyzed to determine the appropriate response to each risk.

Project managers need to ensure that appropriate risk planning, risk identification, risk quantification and prioritization, and risk review occur. In addition, risk responses must be planned, the risk register must be created and maintained, and risk communication plans must be made. This section discusses all of these risk activities.



Risk Planning

Risk planning involves multiple processes to ensure that risks are identified, analyzed, and quantified. The known risks are prioritized, and appropriate responses to each risk are prepared. All of the following activities are part of the risk planning process:

1. **Plan risk management.** Create and edit the risk management plan as risk planning is carried out.
2. **Identify risks.** Determine the project risks and create a risk register.
3. **Perform risk analysis.** Analyze risks both qualitatively and quantitatively to document risk probability and impact, ranking, and urgency. Document this information in the risk register.
4. **Plan risk responses.** Determine the strategies to use for responding to each known risk, and document those strategies in the risk register.

As each step in risk planning is performed, it should result in updates to all related project documentation, such as the risk register (described later in this chapter). Once all risk planning steps are completed and all decisions are documented, the risk management plan is finalized and becomes part of the project management plan.

The *risk management plan* is a document that describes all the known risks that may affect a project and the strategies that will be used to handle each risk. The risk management plan should include the following details:

- **Risk methodology:** Lists the approaches, tools, and data sources to be used for risk management.
- **Roles and responsibilities:** Defines the risk management team members and their responsibilities.
- **Risk budget:** Estimates the funds reserved in the budget for risks. *Contingency reserves* cover known risks, and *management reserves* cover unknown risks.
- **Risk categories:** Groups risks by their potential causes, such as external, internal, or technological.
- **Risk probability and impact:** Defines the likelihood and effect of each risk based on the risk analysis.
- **Stakeholder tolerances:** Defines each stakeholder's tolerance for known risks. This is usually just documented as an overall stakeholder tolerance in monetary terms.
- **Reporting:** Defines how risk activities will be documented, analyzed, and communicated with the project team and stakeholders; uses that information to create the risk management plan.
- **Tracking:** Documents how risk activities will be tracked and audited.

Once risk planning is complete and project work begins, the project manager should ensure that risks are controlled according to the risk management plan. As with all other parts of the project management plan, the risk management plan is considered a living document and may undergo changes throughout the project's life cycle.



Risk Identification

Risk identification is the process of determining in advance what risks may affect a project and documenting them in the risk management plan. By performing these tasks in the Planning phase, the project manager will be able to anticipate risk events and act quickly when a risk occurs. The project manager should work with the

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project team and stakeholders to analyze all aspects of a project—including project cost, schedule, quality, personnel, scope, stakeholders, and procurements—to determine any anticipated risks to the project.

During risk identification, the project manager may decide to employ some or all of the following information-gathering techniques:

- **Brainstorming:** With the help of a facilitator, obtain a list of project risks. Risk categories may be used to help with this process.
- **Interviewing:** Encourage project team members, stakeholders, and subject matter experts to identify risks.
- **Root-cause analysis:** Identify project problems and the causes that led to those problems, and then develop preventive actions.
- **Delphi technique:** Develop a risk list based on expert opinion.

Risk diagramming techniques can also be used to identify risks, including cause-and-effect diagrams, flowcharts, and influence diagrams. SWOT analysis can be used internally to determine risks that could affect the project.

NOTE For details on using SWOT analysis, see Chapter 12, "Project Management Tools."

When risk identification is complete, the project manager can begin creating the risk register (described later in this chapter).

Key Topic

Risk Quantification and Prioritization

Risk quantification involves performing two types of risk analysis—qualitative risk analysis and quantitative risk analysis—to determine the effects of risks on the project objectives.

- **Qualitative risk analysis:** Prioritizes and combines risks based on their probability and impact. Qualitative risk analysis involves performing risk probability and impact assessments to develop a probability and impact matrix, which provides a risk score to guide risk responses. Risk categorization and risk urgency are also determined during this analysis. Risk categories can be based on risk sources, area of project affected, or any other useful distinction. Risk urgency can be assigned based on the probability of detecting the risk, time required to respond to the risk, risk symptoms or warning signs, and risk

ratings. When qualitative risk analysis is complete, each risk's probability and impact, ranking, urgency, and categorization information should be added to the risk register.

- **Quantitative risk analysis:** Numerically analyzing risk effects on project objectives. Quantitative risk analysis involves assigning numerical values to identified risks. Data can be gathered using interviewing, probability modeling, sensitivity analysis, expected monetary value analysis, and other modeling and simulation techniques. When quantitative risk analysis is complete, the risk register is usually updated with a prioritized list of quantified risks.

Both types of risk analysis generally involve using expert judgment as part of the analysis.

When quantifying risks, the risk often equals the probability multiplied by the impact of the risk.

EXAMPLE: If the impact that a web server goes down for one day due to an attack is $100,000 and the probability is that it could happen four times a year, the risk of a single attack on the web server could be quantified as $25,000. This example is simple because quantitative values are assigned, but keep in mind that not all risks can be assessed quantitatively.

The end result of risk quantification is a list of prioritized risks. This *risk prioritization* ensures that risk response plans are developed for every identified risk based on its priority. Higher-priority risks will likely have detailed plans; medium-priority and low-priority risks may not have as detailed plans in the risk management plan. Ensuring that all risks have associated action plans will help the project team know what to do if they encounter a particular risk.



Risk Response Planning

Planning risk response involves developing actions to enhance opportunities and reduce threats to the project. Risks are addressed according to their priority and can be handled by adding resources and activities into the project as needed. This process starts by examining the risk register and analyzing negative risks (threats) and positive risks (opportunities).

NOTE The specific risk responses (positive and negative) are discussed in the "Risk Strategies" section of this chapter.

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In some cases, the project manager will need to create contingency plans that are based on certain events, known as *risk triggers*. Contingency plans should include details on the triggering event or conditions that will cause the plan to be implemented.

Risk Review

Risk review involves periodically investigating risks during the project's Monitoring and Controlling phase to detect any new risks that may have arisen and ensure that planned risk strategies are still effective. Risks should be reviewed whenever a risk event occurs, prior to a phase or stage completion, and whenever situations change that may affect the project. During risk review, all aspects of the project should be reviewed to ensure that all risks have been identified and the risk strategies are still valid.



Risk Register

The *risk register* is the document that charts all risks identified during risk planning. It should contain basic risk notes, risk assessment information, and risk response details. If new risks are discovered during the Executing phase, they should be added to the risk register as well. Figures 8-1a, 8-1b, and 8-1c show three sections of a sample risk register template. Note that in actual practice, these would be contiguous columns on a spreadsheet; the sections are shown separately here for readability.

This log is used to record and track project risks. Risks are things that may or may not happen in the future that could have an effect on a project's success. This log includes all risks identified over the life of the project, including those that have passed and are no longer a threat to the project, those that have been prevented or mitigated, and those that have become issues. Do not delete risk information from this log; it is a permanent record of project risks.

1. BASIC RISK INFORMATION				
Risk Number	**Risk Description / Risk Event Statement**	**Responsible**	**Date Reported Day-Month-Year**	**Last Update Day-Month-Year**
Provide a unique identifier for risk.	A risk event statement states (i) what might happen in the future and (ii) its possible impact on the project. "Weather" is not a risk event statement. "Bad weather may delay the project" is a risk event statement.	Name or title of team member responsible for risk.	Enter the date the risk was first reported.	Enter the date the risk (not the entire log) was updated.
Example R1	Concrete prices may increase, causing the project to go over budget.	Materials Acquisition Manager	1-Dec-2016	12-Jan-2017
Example R2	Key supplier may lose a pending lawsuit and go out of business, creating the need to find a new supplier, which will cause schedule delays.	Project Manager	15-Dec-2016	25-Mar-2017

Figure 8-1a Risk Register Template: Basic Risk Information

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2. RISK ASSESSMENT INFORMATION					
Risk Number	**Impact H / M / L**	**Impact Description**	**Probability H / M / L**	**Timeline N / M / F**	**Status of Response N / P / PE / EE**
	Enter here **H** (High); **M** (Medium); or **L** (Low) according to impact definitions.	List the specific impact the risk could have on the project schedule, budget, scope, and quality. Other impacts can also be listed.	Enter here **H** (High); **M** (Medium); or **L** (Low) according to probability definitions.	Enter here **N** (Near-term); **M** (Medium-term); or **F** (Far-term) according to timeline definitions.	Enter here **N** (No plan); **P** (Planned but not enacted); **PE** (Plan enacted but effectiveness not yet known); or **EE** (Plan enacted and effective).
R1	M	The cost of the concrete could be as much as 50% more expensive than budgeted, resulting in an overall cost overrun of 15% on the budget.	H	M	PE
R2	H	Finding a new supplier, negotiating a contract, and restarting is estimated to cause a 6-month delay.	N/A	N/A	N/A

Figure 8-1b Risk Register Template: Risk Assessment Information

3. RISK RESPONSE INFORMATION			
Risk Number	**Completed Actions**	**Planned Future Actions**	**Risk Status Open / Closed / Moved to Issue**
	List, by date, all actions taken to respond to the risk. This does not include assessing the risk.	List, by date, what will be done in the future to respond to the risk.	State here if the risk is **Open** (still might happen and still has to be managed); **Closed** (has passed or has been mitigated successfully); or **Moved to Issue** (risk has happened).
R1	10-Jan-2017: Asked concrete supplier to guarantee a price; request denied.	12-Jan-2017: Investigating cost of purchasing materials now and storing them until needed.	Open
R2	12-Jan-2017: Met with supplier to discuss options. 15-Jan-2017: Spoke with other suppliers regarding availability. 20-Jan-2017: Prepared contingency plan and RFP in case supplier goes bankrupt. 25-March-2017: Moved risk to issue process; supplier lost lawsuit and declared bankruptcy.	N/A	Moved to issue.

Figure 8-1c Risk Register Template: Risk Response Information

Basic risk notes in the risk register might include the following types of facts:

- **Risk number:** A unique identifier for the risk.
- **Risk description:** What risk might happen and how it might affect the project.
- **Responsibility:** Who is responsible for handling the risk.
- **Date reported:** When the risk was originally reported.
- **Last update:** When the risk information was last updated.

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Risk assessment information in the risk register should include points like these:

- **Impact:** Potential impact of the risk as determined by the risk assessment.
- **Impact description:** Specific impact on project scope, schedule, budget, or other aspects of the project.
- **Probability:** Likelihood that the risk will occur, as determined by the risk assessment.
- **Timeline:** When the risk is expected to occur, usually given in broad terms like *near-term*, *medium-term*, and *far-term*.
- **Status of response:** Whether plans have been made for responding to the risk.

Risk response details in the risk register could include particulars of this kind:

- **Completed actions:** Actions taken for handling the risk.
- **Planned future actions:** Actions still to be completed for the risk.
- **Risk status:** The current status of the risk, such as *open* (still could happen), *closed* (has passed or been successfully mitigated), or *moved to issue* (risk has occurred).

The risk register should be customized to fit the organization's needs.

Risk Communication

Risk communication, particularly risk reporting formats, is documented as part of the risk management plan. It defines how to document, analyze, and communicate with project team members and stakeholders about risks. Most of the documentation will occur in the risk register. However, based on the risk management plan, the project manager will need to communicate with the appropriate personnel regarding risks.

Not every project team member and stakeholder will be interested in the status and plans for every risk. For this reason, some projects may decide to document some reporting information in the risk register, including which team members and stakeholders should be contacted if a risk occurs. No matter which method is used, the main goal is to keep project team members informed of risk status, using each person's preferred communication method.

NOTE For details about project communication, see Chapter 9, "Communication Methods and Influences," and Chapter 10, "Communication Triggers and Target Audiences."



Risk Strategies

Once project risks are identified, analyzed, and prioritized, the project team working with stakeholders and the project sponsor must determine the risk strategy that will be applied to each risk. Risk strategies vary based on whether the risk is *positive* (a desirable event that the project wants to occur) or *negative* (an undesirable event that the project should prevent):

- **Responses for negative risks:** Accept the risk, mitigate the risk, transfer the risk, or avoid the risk.
- **Responses for positive risks:** Accept the risk, exploit the risk, enhance the risk, or share the risk.

The following sections describe these responses and provide examples of each.

NOTE This chapter covers a few more risk strategies than those listed in the Project+ objectives. CompTIA's objective listing includes the following statement:

> The lists of examples provided in bulleted format below each objective are not exhaustive lists. Other examples of technologies, processes, or tasks pertaining to each objective may also be included on the exam although not listed or covered in [the objectives].

Based on the author's real-world experience, and to give the reader a broader understanding of risk strategies, this chapter discusses all of the risk strategies that are recognized in most project management documentation.

Bear in mind that future risk reviews may result in a decision to change the risk status after more information has been obtained about the risk. No risk strategy is written in stone, and a risk that was previously accepted can quickly become unacceptable based on new data. All project management documents are living documents and should be edited as project changes are identified.

Accept Risk

Risk acceptance is a risk strategy for both negative and positive risks. With this strategy, the project team acknowledges the risk but decides not to take any action. For negative risks, accepting the risk is usually chosen when there are no cost-effective methods or suitable response strategies for dealing with the risk. For positive risks, accepting the risk is usually chosen when the team decides not to pursue the opportunity.

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EXAMPLE: A project team identifies an earthquake as a negative risk as part of a building remodeling project. With research, the team finds that the likelihood of an earthquake is very low in that area, and remodeling the building to make it earthquake-proof is both cost-prohibitive and not required by local building codes. In this instance, the project team may decide to accept the risk of damage caused by an earthquake.

Mitigate Risk

Risk mitigation is a risk strategy for negative risks whereby the project team reduces the probability that the risk will occur or lessens the projected impact of the risk.

EXAMPLE: A new web server development project identifies the negative risk that the server will become overloaded, causing performance issues. To mitigate this risk, the project team decides to deploy a web server farm.

Options for mitigating risk include strategies such as developing prototypes before committing to production, adopting simpler processes to reduce user error, implementing more tests, choosing a more stable procurement supplier, and so on. Mitigation doesn't prevent a risk from occurring, but rather limits the effect of the risk if it does occur.

Transfer Risk

Risk transference is a risk strategy for negative risks whereby the risk impact is shifted to another party. This risk strategy almost always involves payment to the other party for taking on the risk. Purchasing insurance is probably the most well-known risk transference method.

EXAMPLE: Company A needs an online e-commerce site. Because the company does not have the manpower or expertise needed to create and manage the site, company A decides to outsource the development and management of the site to company B, a vendor specializing in this type of work. This strategy transfers the majority of the risk for the e-commerce site from company A to company B.

Avoid Risk

Risk avoidance is a risk strategy for negative risks whereby the project team eliminates the risk or protects the project from the risk. The most popular method of this strategy is to edit the project management plan to remove the threat entirely from the project, but this option is not always possible. The most drastic risk avoidance method is to shut down the project.

EXAMPLE: A project planned to use a supplier in a third-world country, but delivery delays from the source have become probable due to political unrest. To avoid the risk, the project team may decide not to purchase from suppliers in unstable or dangerous countries. They could even take it a step further and decide to purchase only from suppliers in the same country where the project is taking place.

Exploit Risk

Risk exploitation is a risk strategy for positive risks whereby the project team ensures that the risk occurs.

EXAMPLE: A bakery is working on a new dessert offering. During development, a new production technique is discovered that could reduce the cost of producing the dessert by 20%. To exploit this opportunity, the project manager ensures that team members are trained in using the new technique.

Enhance Risk

Risk enhancement is a risk strategy for positive risks whereby the project team identifies the key drivers that affect a risk and adjusts them to increase the probability of the risk.

EXAMPLE: A project team identifies a single task in the critical path that could trim an entire month off the project schedule with the help of one additional team member. The project manager decides to add that resource to allow the project to finish early.

Share Risk

Risk sharing is a risk strategy for positive risks whereby partial ownership of the risk is allocated to a third party.

EXAMPLE: A project that is worth pursuing would require Agile development practices. Because the project team has no Agile experts, the team decides to partner with a company that specializes in Agile development so that both companies can benefit from the new project.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

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Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 8-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 8-2 Key Topics for Chapter 8

Key Topic Element	Description	Page Number
Section	Overview of *risk activities*	151
Section; steps; list	Discussion of the *risk planning* process; relationship between risk planning and the risk management plan	151
Section; list	Techniques for *risk identification*	152
Section; example	Overview of *risk quantification*, *qualitative* and *quantitative risk analysis*, and *risk prioritization*	153
Section	Overview of *risk response planning*	154
Section; Figures 8-1a, 8-1b, 8-1c; lists	Definition and example of *risk register*	155
Sections; list; examples	Overview and examples of *risk strategies*, *negative risks*, *positive risks*, and possible *risk responses*	160

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

risk, risk cause, risk impact, risk appetite, risk tolerance, risk activities, risk planning, contingency reserve, management reserve, risk management plan, risk identification, risk quantification, qualitative risk analysis, quantitative risk analysis, risk prioritization, risk response planning, risk trigger, risk review, risk register, risk communication, positive risk, negative risk, risk acceptance, risk mitigation, risk transference, risk avoidance, risk exploitation, risk enhancement, risk sharing

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. You are the project manager for a project to redesign the shelving solutions for your company's jewelry products. These solutions will be sent to retail stores. As part of the project planning, you work with the team members and stakeholders to brainstorm potential pitfalls to the project. Which risk activity is this group working on?
   a. risk quantification
   b. risk identification
   c. risk review
   d. risk response

2. A project team is currently working to assign numerical values to all project risks. Which process are they completing?
   a. risk identification
   b. qualitative risk analysis
   c. quantitative risk analysis
   d. risk prioritization

3. As a project manager, you are responsible for managing all project risks. Recently you discovered that there is a much higher probability that one of the identified risks will occur. What should you do?
   a. Add the risk to the risk register.
   b. Perform risk quantification for the risk.
   c. Change the risk response.
   d. Adjust the risk's probability in the risk register.

4. You are hired to take over managing a project. You are concerned that the original risk planning process did not identify all the project risks. What should you do?
   a. Perform risk review.
   b. Perform risk identification.
   c. Perform risk quantification.
   d. Perform risk planning.

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5. Which project document lists all information about the identified project risks?
   a. risk management plan
   b. probability and impact matrix
   c. risk strategies
   d. risk register

6. You are the project manager for a project to design packaging for your company's giftware line. A mitigation has been discovered for one of the identified risks. However, the mitigation will likely be more expensive than the cost of the risk occurring. Which risk strategy should be selected?
   a. risk mitigation
   b. risk acceptance
   c. risk transference
   d. risk avoidance

7. You are the project manager for a project to create a new storage area network for your company. One of the identified risks is that access to the network will fail. The project sponsor decides to implement a redundant network backbone to ensure accessibility. Which risk strategy is this project using?
   a. risk transference
   b. risk acceptance
   c. risk mitigation
   d. risk avoidance

8. Which of the following options is an example of risk transference?
   a. purchasing builders' risk insurance
   b. bringing in a third party to help complete a project
   c. deploying a server farm instead of a single server
   d. taking actions to ensure that the risk does not occur

9. What are the four risk strategies for handling positive risks?
   a. accept, mitigate, transfer, avoid
   b. accept, exploit, enhance, share
   c. accept, enhance, transfer, share
   d. accept, enhance, mitigate, transfer

10. A team member discovers that a current project at your company could be completed much faster by using a certain proprietary technology. If you approach the technology's supplier with a plan to work with the supplier to complete your project and share its advantages, which type of risk strategy are you employing?

a. risk exploitation

b. risk enhancement

c. risk sharing

d. risk acceptance

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This chapter covers the following topics:

- **Understand communication methods:** Methods include meetings, email and fax, video and voice conferencing, instant messaging and text messaging, face-to-face communication, distribution of printed media, and social media.
- **Understand communication influences:** Influences include language barriers, time zones and geographical factors, technological factors, cultural differences, interorganizational and intraorganizational differences, personal preferences, rapport and relationship building, message content, criticality factors, and stakeholder communication requirements.

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Communication Methods and Influences

Project communication management is the process of planning, collecting, creating, distributing, storing, retrieving, controlling, and disposing of project information. Project managers spend most of their time communicating with project team members and stakeholders. For this reason, effective communication is one of the most important tools used by the project manager.

Communication occurs each time information is exchanged. Communication methods may vary from project to project, or even within a project. The *medium* is the mode of communication, and *noise* is any interference or barrier that affects message delivery. Basic communication involves two entities: the sender and the receiver. The sender encodes a message to the receiver, and the receiver must then decode the message. In some cases, the receiver may acknowledge receipt of the message. Finally, the receiver may provide feedback or a response to the sender's message.

There are three basic communication methods:

- **Pull communication:** Information is stored in a central location, and stakeholders can access the information whenever needed.
- **Push communication:** Information is sent to specific recipients who need it.
- **Interactive communication:** Information is exchanged in both directions between two or more parties.

Communication can take multiple forms:

- Internal communication within the project
- External communication with customers, vendors, other projects, and/or the public
- Formal communication, including reports, minutes, and briefings
- Informal communication, including email, memos, and *ad hoc* discussions
- Vertical communication through the organizational hierarchy

- Horizontal communication between peers
- Official communication via newsletters and reports
- Unofficial, off-the-record communication
- Written, oral, or verbal communication (through voice inflections), and non-verbal communication through body language

Communication plans must be documented by the project manager in order to ensure that project information is sent to those who need it when they need it and in the preferred format (particularly communication with stakeholders). Having formal communication plans also ensures that project documentation is stored in the correct format in a central location.

The project manager should know the number of potential communication channels for the project as a guideline for project communication complexity. The formula for calculating the total number of potential communication channels is $n(n - 1) / 2$, where n is the number of stakeholders or team members who must receive communications. As an example, if a project has 5 stakeholders and team members, the formula is $5(5 - 1) / 2 = 10$, for a total of 10 potential communication channels.

Communication technologies must be chosen carefully based on the needs of the stakeholders. Factors that can affect the choice of a communication technology include how urgently the information is needed, the availability of a communication technology, its ease of use, the project environment, and the sensitivity or confidentiality of the information.

The project manager must understand both the communication methods and influences on communication that affect a project. Proper planning ensures that the methods and influences are documented prior to the completion of project work, thereby enabling the project manager to communicate effectively no matter what situation arises.

This chapter covers the following objectives for the Project+ exam:

3.1 Given a scenario, use the appropriate communication method.

3.2 Compare and contrast factors influencing communication methods.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

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"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 9-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 9-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Communication Methods	1–2
Communication Influences	3–5

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. What is the most effective method of project communication?
   - **a.** instant messaging
   - **b.** social media
   - **c.** email
   - **d.** face-to-face communication

2. Which type of meeting is held to ensure that team members and stakeholders understand the project goals and their part in the project?
   - **a.** virtual meeting
   - **b.** closure meeting
   - **c.** kickoff meeting
   - **d.** video conference

3. Which communication influence would most likely lead to the need for a translator?
   a. cultural differences
   b. language barriers
   c. geographical factors
   d. technological factors

4. Which communication influence is most likely to help ensure good relationships between team members?
   a. building rapport
   b. bringing in a language interpreter
   c. spending time educating the team members about cultural differences
   d. documenting the personal preferences of each team member

5. Suppose all the members of a virtual project team speak the same language but live in various areas around the world. What are the two most likely communication issues that the team will need to address?
   a. language barriers and cultural differences
   b. geographical factors and cultural differences
   c. language barriers and geographical factors
   d. geographical factors and personal preferences

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Foundation Topics

Communication Methods

Project communication occurs using different methods and over different mediums. Project managers must understand all available methods and mediums in order to determine which method and medium are best for any situation that may arise. These choices are influenced by many factors discussed in detail in this chapter. It is the project manager's responsibility to document communication information for all team members and stakeholders. This may include email addresses (both business and personal), phone numbers, instant message handles, and so on. This information is documented as part of the communication plan.

NOTE The communication plan documents communication between the team members and stakeholders. If individuals who are not team members or stakeholders need project information, the project manager should handle it.

For the Project+ exam, project managers must understand the following communication methods: meetings, email and fax, video and voice conferencing, instant messaging and text messaging, face-to-face communication, distribution of printed media, and social media.

Key Topic

Meetings

Project meetings will occur within the project team, but meetings may also be the best way to communicate with project stakeholders, customers, and third parties. The discussion and dialogue in meetings may be conducted face to face, online, and even in different locations.

Team meetings should be held on a regular schedule, such as every workday morning or on Mondays at 10 a.m., and ideally should always take place in the same location, such as in the conference room or on a Google Hangout. Project managers should understand the uses, benefits, and limitations of kickoff meetings, virtual versus in-person meetings, scheduled versus impromptu meetings, and closure meetings.

Kickoff Meetings

A *kickoff meeting* is the first meeting of the project team and project sponsor, held after the Initiating phase of the project, usually during the Planning phase just

before the Executing phase begins. Project stakeholders may also be invited to the kickoff meeting. Prior to the kickoff meeting, the project manager should ensure that the main parts of the project are defined and project planning is complete, including the schedule, budget, and all parts of the project management plan. This meeting is usually considered introductory, so that all the team members can meet each other and understand everyone's part in the project.

The kickoff meeting should not focus on documentation, and the individual team members should already understand their roles in the project. The kickoff meeting just gives the team a chance to meet everyone and to understand how they will all work together to produce the final project result.

During this meeting, team members should identify what they need in order to start their tasks, communicating those needs to the project manager and project sponsor. The project manager is responsible for ensuring that all of the needs identified during the kickoff meeting are met as soon as possible.

The kickoff meeting should have a set agenda to ensure that the meeting does not become mired down in discussing project details. Keep the kickoff meeting short and simple.

EXAMPLE: A project manager completes the Initiating and Planning phases for a project to document the processes used by a furniture manufacturing company. The project includes team members from all the departments at the manufacturing facility. Prior to project execution, the project manager holds a kickoff meeting to ensure that all the project team members and stakeholders understand their roles in the project and how the results they produce affect the other team members.

Virtual Versus In-Person Meetings

Physical meetings between project team members should be preferred, but sometimes holding in-person meetings is impossible. In those cases, virtual meetings may be the only option, especially if project team members are geographically dispersed. A *virtual meeting* is conducted using technology, such as video conferencing, that allows personnel from different geographical areas to attend. As part of the communication plan, the project manager should provide guidelines on when to hold virtual versus in-person meetings. In addition, the communication plan should give specific details (who, where, when, and how) for all meetings.

Keep in mind that even virtual meetings may not be possible if team members are in remote locations or do not have the technology to support a virtual method. These kinds of issues should be fully considered and documented prior to starting the project.

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EXAMPLE: A new environmental project involves team members who work in an office as well as performing environmental testing. While in the field, team members may not be able to attend the project team's daily scrum meetings, which are in-person meetings held in the office. However, weekly project status meetings—which all team members are expected to attend even when in the field—will be virtual meetings. When team members are in the field, they will need appropriate technology to allow them to connect to the virtual meetings.

Scheduled Versus Impromptu Meetings

Most projects will have both scheduled and impromptu meetings. Scheduled meetings occur regularly, often in the same place or over the same medium. They should have a planned agenda. Impromptu meetings will arise as the project conditions change or emergencies occur. Because impromptu meetings are variable, establishing guidelines for them is difficult. If an impromptu meeting occurs, document the attendees and the results to ensure that all affected team members and stakeholders receive updates from the meeting.

EXAMPLE: A new environmental project includes a kickoff meeting, daily scrum meetings, weekly project status meetings, and milestone meetings that are included in the project schedule. When a team member identifies a new species of fish during her fieldwork, the expertise of several team members is needed to determine the impact of this discovery on the project. For this situation, an impromptu meeting should be called, and the results of the meeting can be communicated to the rest of the team in the next weekly status meeting.

Closure Meetings

Project *closure meetings*, also called *close-out meetings*, must be held as soon as possible after actual project completion, in order to ensure that final project information is recorded while the knowledge is still fresh. During this meeting, the attendees should review the project and decide what the organization can learn from it. The product of the closure meeting is a "lessons learned" document that is made available to future projects, managers, and teams. The closure meeting should answer and document questions like these:

- What were the major project successes?
- What were the major challenges?
- What was learned about scheduling, budgeting, and risk management?
- Were the right people included in the project team? If not, who could have made the project more successful?

NOTE In some cases, confidential information will need to be included in the "lessons learned" document. Any document that includes confidential information should have a defined access control list (ACL) to ensure that only authorized personnel can read that document. If someone needs access and does not have the appropriate permissions, a redacted version of the "lessons learned" document should be provided.

Key Topic

Email and Fax

Communicating via email is more common today than communicating via fax. In most cases, email or fax communication has no method for verifying that the communication has been read, although verifying receipt is generally possible. Retaining sent email ensures proof of communication, but proof of communication by fax is more difficult without cooperation from the receiving party. For most projects, email and fax communication are considered informal communication methods.

Some stakeholders and project team members may prefer email versus other types of communication. The project manager should note such preferences in the stakeholder register and other project documents.

EXAMPLE: A new project will create a prototype for a new eco-vehicle design. The project team members work from multiple global locations. In this project, email will likely be the most common type of communication between team members. However, the project manager should regularly schedule virtual project status meetings using video or voice conferencing. Most documentation should be shared using the cloud. In cases where signed paper documents need to be transmitted, faxing the signed documents would be the quickest way to ensure that the documents reach their destination in a timely manner. The originals of all faxed documents should be retained either at the sending location or receiving location (if the original documents are shipped to the receiver). These processes should be defined in the communication plan.

Key Topic

Video and Voice Conferencing

Video and voice conferencing are excellent communication tools, particularly if project team members are geographically dispersed. However, keep in mind that attendees will need the resources to carry out the video or voice conference. If using an Internet connection, video conferencing requires more bandwidth than voice conferencing, but video conferencing provides the added benefit of being able to see other attendees and read their body language.

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With either of these communication methods, project managers must ensure that attendees have the appropriate hardware and software resources to participate in the conference.

EXAMPLE: A new application development project involves team members located throughout the United States. Most team members have high-speed Internet connections, but one lives in a rural area and has limited bandwidth. Voice transmissions usually work well over his connection, but video transmissions are often glitchy. The project manager should ensure that the team understands this team member's limited bandwidth, encouraging the team to use voice conferencing for any calls involving this team member. For calls that do not involve this team member, video conferencing should be used. This information should be documented in the communication plan.

Key Topic

Instant Messaging and Text Messaging

Instant messaging and text messaging are common communication methods today. While the two terms are often used synonymously, they actually describe two different technologies. *Instant messaging* uses computer or mobile applications managed by a provider, such as Google or Microsoft. *Text messaging* is textual "conversations" conducted on mobile devices via the cell phone provider's communication bandwidth. Fortunately, both types of vendors have come up with solutions to provide access across multiple platforms. Most instant messaging apps can be installed on mobile devices and cell phones. Text messaging applications can be installed on computers and other devices that allow communication with cell phones.

Both forms of communication offer advantages:

- Communicating without speaking allows the user to be involved in other activities (such as in-person meetings) while messaging.
- Multiple conversations can occur without all parties being involved simultaneously.
- Faceless communication gives some people increased confidence, allowing them to communicate information they would be reluctant to say in person or by phone.
- Messaging is generally convenient in almost all locations.
- Responding to a message can be delayed to a more convenient time.

Of course, messaging also has some disadvantages:

- Misunderstanding is common because tone and body language cannot be transmitted.

- Lost or out-of-order messages can cause confusion.
- Abbreviations or lingo may be misunderstood.
- Messaging has built-in character limits.
- Autocorrect and text-to-voice features can often result in communication errors.

Project managers need to understand the limitations of messaging methods. It may be important to have a policy requiring all recipients to acknowledge messages, in order to ensure that all messages are received and read. No matter what the policy is, both messaging methods should only be used for informal communication or to call emergency or impromptu meetings. In addition, organizations may want to adopt a policy whereby all text or instant messages are retained for a permanent record. Keep in mind that some applications do not provide this functionality.

Project managers should explain the rules of texting within the team. While this form of messaging is great for quick questions, typing a long response on a mobile device's keypad can be annoying for some users. If a message requires more than a sentence in reply, using email may be a better choice.

EXAMPLE: A retail store remodeling project involves several teams of contractors managed by a general contractor, all of the teams working at the store location. The project manager holds weekly status meetings with the general contractor. When the project sponsor requests the current status of a specific aspect of the remodel, the project manager wants to provide the most updated information. In this case, a text message to the general contractor or even a subcontractor would obtain the necessary information quickly.



Face-to-Face Communication

Project managers often prefer face-to-face communication. Whether in formal scheduled meetings or impromptu meetings, face-to-face communication is the most effective method, especially when making project decisions. Kickoff meetings, change control board meetings, and closure meetings are usually conducted face to face. Some shareholders may also prefer to receive certain important communications, such as project status updates, face to face. Project managers need to document specific details about this communication preference in the project communication plan.

EXAMPLE: A project to create documentation for a new application was started a few months ago. The marketing department notifies the project sponsor that a customer has already expressed interest in purchasing the new application, and the sponsor decides to speed up the project schedule. The project manager holds

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a face-to-face meeting with the team members to get ideas on ways to crash the schedule. Meeting face to face helps ensure that all possible solutions are fully discussed by the project team and then documented so that the sponsor can make a final decision on what to do. The project manager must perform a thorough analysis of proposed options, making sure that all constraint changes are understood. A crashed schedule usually means a higher budget and more resources will be needed.



Distribution of Printed Media

Most projects result in a plethora of documentation, usually distributed in printed form. Often this documentation is also stored in a central location to provide easy access for team members and stakeholders. Project managers should retain a list of printed media that pertains to the project, noting who owns the master files or should receive copies. Recording this information will help ensure that all interested parties receive documentation when it becomes available and that documentation is not lost if a team member suddenly leaves a project.

Many organizations today rely on the use of cloud or document-sharing applications to distribute documents to multiple recipients. Project managers need to choose the best solution that provides the features needed by the project. Team members and stakeholders should be granted appropriate access to each document; some people may need full read-and-write permissions, and others may have only read permission.

EXAMPLE: A project is adopted that will create marketing material for a new high-tech toy. As the graphic designer creates images for use in the marketing material, team members view the digital images after they are uploaded to the cloud. The project manager needs to document at which point physical copies of these images or other media will be printed and distributed to the team. In some cases, graphics and marketing material can look vastly different when viewing digital images versus physical copies.



Social Media

Social media such as Facebook and LinkedIn are used today for both personal and business needs. Organizations can create private groups that include only team members and stakeholders, using these groups to communicate and distribute appropriate material. As the features of social media applications evolve, project managers will need to be aware of these changes, looking for new ways to use this communication method.

Social media should be handled with great caution. It is often easier to disallow posting to social media outlets than to ensure that team members understand and

follow the organization's social media guidelines. Some projects may need to employ public relations (PR) personnel to ensure that the appropriate message is published to social media. Involving PR professionals reduces the likelihood of confidential or sensitive information being released inadvertently.

EXAMPLE: A large online retailer is designing an innovative electronic device that will create a digital shopping list based on past shopping habits and the contents of the user's home pantry and refrigerator. The project manager informs all team members of the confidentiality of the project and obtains a signed non-disclosure agreement (NDA) from each person. The NDA specifically prohibits publishing information about the project in any social media forum. In this project, the only social media posts that allude to the new product should come from the company's marketing department, and those posts can then be shared by the team members.



Communication Influences

Often the communication methods used by project teams are influenced by other project factors. Understanding these influences can help a project manager determine the best communication method to be used in various circumstances. It is always best to anticipate these influences and make plans for them.

Project communication is influenced by language barriers, time zones and geographical factors, technological factors, cultural differences, interorganizational and intraorganizational differences, personal preferences, rapport and relationship building, message content and criticality factors, and stakeholder communication requirements. As part of planning for communication, all of these details should be documented, including specific stakeholder communication requirements. The project manager should document the necessary communication frequency, level of report detail, types of communication, confidentiality constraints, and preferred communication style.

Language Barriers

Language barriers influence project communication when team members or stakeholders speak different languages. The effects are usually easy to anticipate. If project team members or stakeholders speak different languages, the project manager will have to find ways to overcome any communication issues that may arise. Solutions may involve translating documents, employing interpreters for verbal communication, using visual methods of communication and training, and so on. Another strategy is for the affected team members to learn some basics of the other language(s) needed, which is also an excellent means of team building. Even though mastery of the other language is rarely achieved, just learning the basics can help with simple communication.

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While verbal language barriers seem obvious, projects may also involve hearing-impaired personnel. Sign language interpreters may be needed. Some deaf or hearing-impaired people read lips, but that does not help if they speak or read in a different language from other people with whom they need to communicate.

Project managers need to make all team members aware of any language barriers, working to ensure that all communications address the language needs of all recipients.

Time Zones and Geographical Factors

Like language barriers, time zones and geographical factors influence project communication in ways that are easily anticipated. If project team members or stakeholders work in different time zones or geographical areas, this information should be documented. The project manager needs to be careful when setting up the project schedule and meetings to ensure that time and location differences will not adversely affect scheduled tasks and their dependencies. Some meetings or other communications may need to occur while team members in other time zones are unavailable. In such cases, everyone who missed the meeting or other communication will need an update as early as possible.

Project managers need to make sure that all team members understand any relevant time zone or geographical factors and work to ensure that all communications are time-appropriate.

EXAMPLE: A project manager and most of her project team members are based in the company's main office in New York, NY, USA, on Eastern Standard Time (EST), UTC –5. Several other team members are located in the office in New Delhi, India, on India Standard Time (IST), UTC +5.5. Other team members work from London, England, on Greenwich Mean Time (GMT), UTC +0. To gather the entire team for weekly meetings, the project manager might schedule half-hour video conferences at 8:00 a.m. EST (6:30 p.m. IST, 1:00 p.m. GMT), so that the New Delhi team members are not held in their office late into the evening. The occasional impromptu meeting at 1:00 p.m. in New York might allow for including London team members (6:00 p.m. local time) but would exclude New Delhi team members by falling at 11:30 p.m. IST. The project manager might also choose to host a daily remote standup meeting from her home at 6:00 a.m. EST that included only the international team members (4:30 p.m. IST and 11:00 a.m. GMT), and then hold a second daily standup in the office for the New York team members at 10:00 a.m. EST. During the second standup, the project manager could share any issues reported by the remote team members in the morning meeting.

TIP If a team is spread across multiple time zones, some of which observe Daylight Saving Time (DST), meeting arrangements also need to accommodate scheduled clock changes. For example, as this book goes to press, New York is on Eastern Daylight Time (EDT, UTC –4) and London is on British Summer Time (BST, UTC +1). New Delhi does not observe DST, which means that the time difference between the New York/London teams and the New Delhi team in the previous example decreases by one hour during DST.

Be sure to consider how geographical factors combine with time factors. Team members located in multiple countries—or even different areas of the same country—might celebrate an event, schedule procurement shipments, travel, release products, and so on quite differently on the same day, based on the local season, prevailing weather conditions, governmental and civic regulations, etc. As a simple example, Christmas Day occurs on the same date (December 25) around the world, which is in winter in the earth's northern hemisphere and summer in the southern hemisphere. Similarly, in the previous project example, the project manager may need to work out a different weekly meeting schedule during winter months in New York, when ice or snow can make morning traveling hazardous. See the later section "Cultural Differences" for a discussion of how culture (such as religious observances) also affects projects.

Technological Factors

Technological factors influence project communication in ways that may not be as easily anticipated as language barriers or geographical factors. The project manager should document any existing or potential technological issues and attempt to resolve them, if possible. If technological factors cannot be overcome, the project manager should document those factors and plan to minimize their impact on communication as much as possible.

All team members must understand any relevant technological factors and work to ensure that all communications are minimally affected by those factors. Today's businesses often rely heavily on electronic communication, but every type of electronic communication has unique accessibility issues. For example, not everyone can read or type text messages on a mobile device. Shrinking device sizes, in particular, affect older populations as well as the visually or physically handicapped. Documenting types of communication that team members or stakeholders do not like or cannot use is just as important as documenting their preferences.

One very important technological factor is security. Devices issued to personnel may need security controls to protect the organization's confidential assets. To allow team members to complete their duties, security controls sometimes may need to be

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disabled or overridden temporarily to give devices necessary functionality. Alternatively, additional controls may need to be installed to ensure that the organization's assets are fully protected.

EXAMPLE: A company is developing an application that will give users a detailed mapping of the devices located on the company's network. Several team members are tasked with testing the functionality of the application. However, the computers issued to those team members will not allow them to install an application without administrator credentials. In this case, the project manager may need a temporary administrator-level account to install the application. Another option is to temporarily disable whatever control is preventing application installation. Either way, after testing is complete the IT department will need to ensure that the temporary administrative account is disabled or deleted, or the control is re-enabled.

Cultural Differences

Cultural differences are based on a person's ways of thinking about, seeing, and hearing the world. A person's culture helps shape how that person sends and receives messages. The same words can have different meanings to people in different cultures. Add a language difference into this cultural mix, and the potential for influencing communication issues increases.

Cultural differences can constrain a project in several ways:

- *Cognitive constraints* are the cultural world views that provide a backdrop to which all new information is compared. Examples include religion, literacy level, gender, and economic status.
- *Behavioral constraints* are the behavioral rules for each culture that affect verbal and nonverbal communication. Examples include eye contact, direct discussion versus talking around an issue, and even how close people stand to each other.
- *Emotional constraints* are the cultural rules for displaying emotion. Examples include yelling, crying, deference, and any other exhibition of emotion.

The project manager must understand cultural differences among team members and stakeholders. Often the project manager will need to ensure that team members also understand these cultural differences, which is key to ensuring effective communication.

EXAMPLE: A project involves teams in two different countries. During weekly project video conferences, the team in one country makes promises that often are not met by the end of the week. The team in the other country becomes increasingly frustrated at these unfulfilled expectations. The project manager consults

an expert who explains that cultural differences, such as an unwillingness to tell superiors "no" when requests are made, may be causing these issues. The cultural expert is then engaged to provide training to both teams on how to improve their interaction and teamwork.

Interorganizational and Intraorganizational Differences

Interorganizational differences are the differences between organizations, and *intraorganizational differences* are the differences within an organization. Both types of differences influence project communication. Often different organizations or departments within an organization have vastly different communication requirements, depending on the organization's management style. Project managers need to recognize these differences and work with them.

EXAMPLE: An outside contractor is required to provide daily email updates to her company on the status of all her project tasks. On one project, the project manager only requires his team (the contractor and some in-house team members) to submit bi-weekly email updates. To avoid duplicating effort, the contractor decides to copy that project manager on her daily updates to her company. Otherwise, she would be sending out daily updates to her company as well as bi-weekly updates to that project manager.

The project manager must understand all the interorganizational and intraorganizational differences that affect project communication and find ways to address any differences that affect the project or the project team.

EXAMPLE: All stakeholders on a certain project receive weekly email status updates. The project manager sends these messages immediately following the team's weekly project status meeting. One stakeholder attends the status meetings approximately every other week. Over a couple of meetings, it becomes apparent that this stakeholder is not reading any of the status updates, because she often asks basic questions about topics that were thoroughly addressed in the previous meeting and discussed in the status email. Answering her questions wastes meeting time. The project manager should inquire if the stakeholder is receiving the email messages and encourage her to read them. If the problem is not resolved, it may be necessary to involve the stakeholder's supervisor to prevent wasted time.

Personal Preferences

Most individuals prefer certain types of communication. Project managers should work with all project team members and stakeholders to identify their preferred methods of communication. While communicating via the preferred method may not always be possible, documenting those preferences is useful to ensure that the team knows the best methods to use to contact any individual. For example, some

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team members may not want to be contacted via personal email addresses or home landline numbers. However, the project manager should list multiple routes of contact for every team member in case a preferred method is not available (such as during email server maintenance or a power outage).

In emergency circumstances, the most efficient communication method is usually the method that should be used, whether or not it is the preferred method.

These preferences are best tracked in the communication plan, but may be further broken out in a communication list that is accessible by the entire project team—not all project communication, especially in emergencies, may involve the project manager. Team members should be encouraged to print this list in case electronic technology fails, preventing access to digital files.

Building Rapport and Relationships

Rapport is getting along with another person or group, based on finding common ground. Building rapport among project team members helps develop relationships between the individuals and groups. At the start of the project, introductory exercises that work to break the ice can help the team members develop rapport. Project managers should work to find commonalities between the team members, such as shared experiences, sports preferences, hobbies, and the like. Integrating humor into the introductions can help.

CAUTION Project managers may need to provide guidance to team members on humor. One person's funny anecdote can be perceived by another as a sexist remark. Such concerns often tie back into cultural differences.

Because some people are naturally less likely to share personal information, project managers may decide to give each team member a brief introduction during the kickoff meeting and then ask each person to share something unique about himself or herself. Another excellent technique for building rapport is to ask team members to take turns leading team meetings once the project work is underway. Some project members might even launch a project portal that lists all the team members, their accomplishments, their contributions to the project, and other interesting tidbits of information. No matter what methods are used, the key is to help the team members get to know one another so that they feel comfortable working together.

Without rapport among team members, the project may experience communication issues because team members do not feel comfortable expressing themselves. It is important that the project manager lead the effort to build rapport between the team members.

Message Content and Criticality Factors

Message content is an influence on project communication because the content may determine the audience and the communication method used. Emergency communications may need to be sent over a fast delivery mechanism, such as instant messaging, whereas weekly status reports may travel via a less urgent medium, such as email. The communication plan for the project (part of the project management plan) should document the anticipated types of communication, their purposes, and their expected methods. Project team members and stakeholders can refer to this document to determine how information should be transmitted.

Message criticality is an influence on project communication because critical messages must be delivered in a timely manner. Normal project communication may not need as timely delivery but may need to be edited and accessed via multiple methods. The project manager may need to designate criticality levels (such as *normal*, *elevated*, *critical*, and *emergency*) and provide guidelines for assigning these levels to project communication.

The project manager should account for all types of messages and provide guidance on methods for emergency communications, change communications, project status communications, quality assurance communications, budget communications, schedule communications, and so forth. This guidance ensures that team members know how to handle every type of communication, without having to contact the project manager constantly for instructions. In addition, the project manager should document all criticality levels and the communication methods used for each.

Stakeholder Communication Requirements

Stakeholders may provide the project manager with specific communication requirements based on their preferences. The project manager should document these requirements in the communication plan. Some stakeholder requirements may fall within already defined regular project communications, but other preferences may fall outside those parameters. Common stakeholder requirements include frequency of communication, level of report detail, communication types, confidentiality constraints, and tailored communication styles. Generally this type of detail is most easily documented in a chart or spreadsheet. Creating communication templates may be the best way to ensure that all stakeholder communication requirements are met.

Communication Frequency

Stakeholders may specify a particular frequency for project communications. As an example, most stakeholders on a project may want to receive weekly project status reports, but one wants a status report every other day. In this case, it may be easiest

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to involve the one stakeholder in daily team meetings. Otherwise, the project manager will need to find a way to get that stakeholder the information he needs every other day.

Stakeholders may also want to interact regularly with the project team. Project managers should try to encourage this communication at the time of other regularly scheduled meetings, to maximize team efficiency.

Level of Report Detail

Some stakeholders may require a higher or lower level of report detail for certain project communications. Suppose most of your team's stakeholders want project status reports to show only task start and finish info, but one stakeholder also wants to know which project team members are working on each task. The easiest solution might be to create one report that includes all of the information needed by all stakeholders, rather than producing different reports based on stakeholder needs. If one report does not address everyone's needs, the project manager could use separate report templates to ensure that all the essential information is included in each report.

Types of Communication

Stakeholders often prefer certain types of communication, including the methods defined earlier in this chapter. As an example, most stakeholders on a project might prefer to receive text messages for all emergency communications, while other stakeholders prefer email because the mobile phone signal in their area is unreliable. In this case, the message being communicated could be the same, just using a different medium. Documenting such requirements helps ensure that the appropriate communication method is used for each stakeholder.

Confidentiality Constraints

Some project communication may have confidentiality constraints, such as information that can requires certain security clearance levels. This situation is typical with projects related to development of new technology or involving government entities. Communications documentation in such cases should include the confidentiality level of each stakeholder to limit access.

EXAMPLE: A company is working on a new engine that uses an alternative fuel source. Because information on this project would be valuable to competitors, the project manager must ensure that all project communications are evaluated for confidentiality. Some communications, such as project status reports, may have low confidentiality levels and be appropriate for all stakeholders. Other communications,

such as research and development findings that include trade secrets, may be limited only to certain stakeholders with the appropriate security clearance.

If confidentiality constraints are important, the project manager will need to document the different levels of confidentiality as well as which types of communication fit into each level. An access control list will also be needed, to map the access levels for each stakeholder.

Communication Style

Project managers may need to tailor their communication styles based on the behavioral characteristics of the stakeholders. To deal with different personality types, the Dominant, Influence, Steadiness, Cautious (DISC) method of categorization helps project managers to understand individual stakeholders' behavioral styles:

- **Dominant personality:** Dominant individuals, also referred to as *direct* or *controlling*, require communications that are brief and compelling. Basically, these people prefer just the facts, without a lot of details.
- **Influencer personality:** Influencers are very social, preferring back-and-forth communication. Influencers want details, and in turn provide a lot of feedback.
- **Steadiness personality:** Stakeholders with the steadiness style are calm, cool, and collected. These stakeholders will be loyal once they are convinced of the need for the project, and they thrive on sincere appreciation.
- **Cautious personality:** Because cautious stakeholders are task-oriented, they prefer that other people call to set up an appointment, instead of dropping by and potentially breaking their creative flow. When dealing with this personality type, the project manager should be fully prepared for face-to-face meetings with detailed documentation in writing.

Project managers must adapt their individual styles to meet the needs of each of these personality types. Adjusting communication methods to fit each stakeholder will help ensure more successful project communication.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

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Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 9-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 9-2 Key Topics for Chapter 9

Key Topic Element	Description	Page Number
Sections; list; examples	Discussion of project communication via various meeting types	173
Section; example	Discussion of project communication via email and fax	176
Section; example	Discussion of project communication via video and voice conferencing	176
Section; lists; example	Discussion of project communication via instant messaging and text messaging	177
Section; example	Discussion of project communication via face-to-face meetings	178
Section; example	Discussion of project communication via printed media	179
Section; example	Discussion of project communication via social media	179
Sections; lists; examples	Discussion and examples of how project communications are affected by language barriers, cultural differences, and other factors	180

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

communication medium, noise, kickoff meeting, closure meeting, virtual meeting, instant messaging, text messaging, language barriers, cultural differences, cognitive constraints, behavioral constraints, emotional constraints, interorganizational differences, intraorganizational differences, rapport

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. Your company needs to redesign the shelving solutions for its jewelry products. All planning for this project is complete, and the project team has been selected. As the project manager, you need to introduce all the team members and make sure that they understand their project duties. What should you do?
   a. Send an email message.
   b. Hold a video conference.
   c. Hold a scheduled meeting.
   d. Hold a kickoff meeting.

2. A project team is working on separate project tasks in different geographical locations. All team members are located in U.S. time zones and have access to communication technology. You want to have a face-to-face meeting with the team. Which type of meeting should you hold?
   a. closure meeting
   b. in-person meeting
   c. virtual meeting
   d. kickoff meeting

3. A project manager works with the marketing and public relations departments to develop a series of press releases for a current project. These releases should be published regularly throughout the project to update customers and other interested parties on the progress of the project. Which communication method is best for this purpose?
   a. instant messaging
   b. social media
   c. voice conference
   d. video conference

4. You are hired to take over a project. Based on the previous project manager's notes, you are concerned about conflict between two team members. What is the best method of determining whether communication between the two people is a problem?
   a. Hold separate face-to-face meetings with each of the team members.
   b. Hold a single face-to-face meeting with both team members.
   c. Hold a virtual meeting with each of the team members.
   d. Hold a single virtual meeting with both team members.

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5. You are the project manager for a software development project. When the project started, all team members were in a single location in New York. Three team members left and were replaced by team members in Madrid. All the team members work on the same schedule. Not everyone speaks English. What should be your primary concern regarding project communication?
   a. cultural differences
   b. language barriers
   c. geographical factors
   d. relationship building

6. You are the project manager on a project to design a new application that needs to be first to market. This application will have several proprietary advances that must be protected. One of the stakeholders has requested access to project information that is considered confidential, and the stakeholder is not approved to receive this information. What should you do?
   a. Consult with the project sponsor to verify that the stakeholder needs the information.
   b. Deny the stakeholder's request.
   c. Grant the stakeholder limited access to the information.
   d. Give the stakeholder access to a redacted copy of the information, removing the confidential information.

7. You are the project manager for your company. All of the team members for your current project are employees of other departments. You have asked for daily verbal status updates as part of the scrum meeting. A couple of the team members want to submit written weekly project status reports, as required by their departmental supervisor. What communication influence is occurring?
   a. cultural differences
   b. confidentiality constraints
   c. intraorganizational differences
   d. interorganizational differences

8. Project managers need to recognize when technological factors influence project communication. Which of the following is an example of this influence?
   a. One team member has been hired as a contractor for this project.
   b. One team member works in a different time zone than the other members.
   c. One team member speaks English as a second language.
   d. One team member has unreliable Internet access.

9. You have identified one stakeholder on your project as a dominant personality type. You need to relay some project information to this stakeholder. This stakeholder prefers face-to-face communication, except in emergency situations. Which type of communication should you use?
   a. Provide just the facts in writing.
   b. Provide lots of detail in writing.
   c. Provide lots of detail orally.
   d. Provide just the facts orally.

10. During a current project, you want to ensure that the project team members and project stakeholders are able to work together to achieve the project goals. What activity should you carry out during the kickoff meeting?
   a. Discuss personal communication preferences.
   b. Explain language barriers.
   c. Perform a rapport building exercise.
   d. Explain cultural differences.

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This chapter covers the following topics:

- **Understand communication triggers:** Triggers include audits, project planning, project changes, risk register updates, milestones, task initiation/completion, gate reviews, incident responses, and business continuity responses.
- **Understand communication target audiences:** Target audiences for communication include the project sponsor, stakeholders, and team members.
- **Understand communication rationale:** Rationale behind project communication.

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Communication Triggers and Target Audiences

Communication triggers are project events or conditions that must be reported to the appropriate audience after they occur. During the Planning phase of a project, the project manager creates the project management plan and its subsidiary documents, which include the communication plan. This plan details the communications that must occur during the Executing, Monitoring and Controlling, and Closing phases of the project, and it lists the target audiences for these project communications. The project manager is responsible for knowing when and how involved parties should be kept in the loop.

This chapter discusses common triggers for project communication, as well as the target audiences and rationale for each type of communication.

This chapter covers the following objective for the Project+ exam:

3.3 Explain common communication triggers and determine the target audience and rationale.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 10-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 10-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Audits	1
Project Planning	2
Project Changes	3–4
Risk Register Updates	5
Milestones	6
Task Initiation/Completion	7, 10
Gate Reviews	8
Incident Responses and Business Continuity Responses	9

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which communication trigger is the result of verifying compliance with project requirements?
   - **a.** gate review
   - **b.** project milestone
   - **c.** project change
   - **d.** project audit

2. Which project entities should have at least read-only access to all documents created during the Planning phase? (More than one answer may be correct.)
   - **a.** procurement vendors
   - **b.** project team members
   - **c.** project sponsor
   - **d.** project stakeholders

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3. Which of the following changes is likely to alter the project's schedule if approved?
   a. A stakeholder is added.
   b. A team member is added.
   c. A team member has a higher rate of pay than expected.
   d. A stakeholder identifies a new requirement.

4. Which of the following changes is likely to alter the project's budget if approved?
   a. A procurement will cost more to complete.
   b. A procurement will take longer to deliver than expected.
   c. A new stakeholder is added.
   d. The project sponsor is unavailable for a gate review.

5. During project execution, a new project risk is identified. Which project entity should be notified once the risk management plan is updated?
   a. project sponsor and project team members
   b. project stakeholders and project team members
   c. project sponsor and project stakeholders
   d. project sponsor, project stakeholders, and project team members

6. Why should project milestones be noted on the project schedule?
   a. to ensure that proper communication occurs
   b. to ensure that dependent tasks start on time
   c. to ensure that time is allocated for the milestone to be completed
   d. to ensure that the project is reviewed by the CCB

7. Which communication trigger ensures that a dependent activity starts?
   a. gate review
   b. task initiation/completion
   c. milestone
   d. audit

8. During a project, the project managers from the different phases meet with the project sponsor to decide whether the project will proceed. What is this process called?
   a. gate review
   b. milestone
   c. audit
   d. change control process

9. Which project event may result in a business continuity response?
   a. audit
   b. change request
   c. incident
   d. approved change request

10. A project task cannot be started until its predecessor task finishes. Which type of task relationship is this?
   a. start-to-start (SS)
   b. start-to-finish (SF)
   c. finish-to-finish (FF)
   d. finish-to-start (FS)

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Foundation Topics

While project communication happens on a daily or hourly (or even minute-by-minute) basis according to the project needs, certain types of project communication are formal and predictable, such as cost reports, status reports, and quality reports. Other types of communication may not be intuitively obvious, but they also need to occur to ensure that no hidden pitfalls derail stakeholder expectations.

As with planning risk responses, project managers must be prepared to communicate ordinary project updates while also knowing how to respond in worst-case scenarios. Communication triggers are events or conditions in the project that require communication with the project team and stakeholders. For the Project+ exam, project managers must understand communication triggers and target audiences, including audits, project planning, project changes, risk register updates, milestones, task initiation/completion, gate reviews, incident responses, and business continuity response.



Audits

Audits are part of the Monitoring and Controlling phase of a project. An *audit* verifies that project deliverables comply with the guidelines set forth in the project management plan, in order to validate the performance of the project. Audits are usually performed to validate a project's scope, quality, and regulatory compliance, but they also can verify cost or schedule compliance, identify new risks, or determine whether a risk is about to occur.

Project audits offer two main benefits:

- Obtaining tangible data about specific components, to determine how the project is aligning with its objectives
- Motivating team members and stakeholders, who see audits as evidence of managerial oversight

Audit results should be analyzed carefully to determine whether the project is performing as expected. If any issues are discovered, they should be documented as part of the audit report. Based on the audit results, the project manager should work with the project team to identify any corrective actions that could improve issues identified by the audit.

When the audit report is completed, the project manager should distribute the results of that audit to the recipients listed in the project's communication plan. Typically, these reports will be shared with project team members, the project sponsor, and any project stakeholders that request audit results. Communicating the

audit results with the project sponsor and stakeholders allows them to analyze the results and provide any applicable feedback. Communicating the audit results with the project team members ensures that they understand any audit findings that may affect their project tasks or schedule. Audits are defined in the subsidiary plans of the project management plan: Quality audits are defined in the quality management plan, cost audits are defined in the cost management plan, and so on.

EXAMPLE: The project management plan for a manufacturing project includes regular audits to ensure that the parts being produced fit within certain design specifications and cost ranges. If the audit shows that none of these values are outside the required standards, the project manager sends a normal audit report. However, the communication plan includes an audit trigger that instructs the project manager to hold a meeting with certain team members if values fall outside the quality or cost specifications, to discuss what adjustments need to be made to the project to address these issues.

Key Topic

Project Planning

The majority of the project planning documentation is created during the Planning phase of a project. Because each of these documents is important to project success, project managers should ensure that all of the documents are stored in a central location and that individuals who need access to them can, at minimum, read the documents.

The project management plan describes how the project will be executed, monitored, and controlled. This document consolidates a number of subsidiary plans and baselines. Each of these documents has a specific purpose, as discussed in Chapter 1, "Project Properties and Phases." Once each document is created, it is important to ensure that the recommended target audience receives or is granted access to the document (see Table 10-2). However, organizations and their project management office might need to customize the target audience for a document, based on the project and organizational requirements.

NOTE Chapter 1 of this book focuses on the subsidiary plans and baselines specified in the objectives for the Project+ exam, which (as stated by CompTIA) is not a comprehensive list. Table 10-2 includes some additional components listed in project management standards. Across the industry, some component names may vary (such as *communication plan* versus *communication management plan*). Watch for potential name variants on the Project+ exam that might trip you up.

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Table 10-2 Project Management Plan Components and Target Audiences

Component	Recommended Target Audience
Change management plan	Project sponsor and stakeholders, change control board, any project team members with change process roles
Communication plan	Project sponsor and stakeholders, any project team members with communication roles
Configuration management plan	Project sponsor and stakeholders, project team members
Cost baseline	Project sponsor, any project team members with budgetary roles
Cost management plan	Project sponsor and stakeholders, project team members
Human resource management plan	Project sponsor and stakeholders
Process improvement plan	Project sponsor and stakeholders, project team members
Procurement management plan	Project sponsor and stakeholders, procurement vendors, any project team members with procurement roles
Quality management plan	Project sponsor and stakeholders, any project team members with quality control/assurance roles
Requirements management plan	Project sponsor and stakeholders, project team members
Risk management plan	Project sponsor and stakeholders, project team members
Schedule baseline	Project sponsor and stakeholders, project team members
Schedule management plan	Project sponsor and stakeholders, project team members
Scope baseline	Project sponsor and stakeholders, project team members
Scope management plan	Project sponsor and stakeholders, project team members
Stakeholder management plan	Project sponsor, project team members

Because these documents are subject to change over the entire project life cycle, project managers should establish a version control process and should communicate with the appropriate individuals and groups when changes have been made in the documents.

Key Topic

Project Changes

A *change request* is a formal proposal to modify any document, deliverable, or baseline. Change requests are entered into the *change log*, which is a comprehensive list of changes requested during the project. The change log includes the date and time, cost, risk impacts, and other details of the change (see Figure 10-1 for an example).

Change Log							
Project:						**Date:**	
Change No.	**Change Type**	**Description of Change**	**Requestor**	**Date Submitted**	**Date Approved**	**Status**	**Comments**
Each change request is assigned a reference number.	This may be a design, scope, schedule, or other type of change.	The change request should be described in detail.	Who initiated the change request?	When was the request submitted?	When was the request approved?	Is the change request open, closed, or pending? Has it been approved, denied, or deferred?	This section may describe why the change request was rejected or deferred, or provide any other useful information.

Change Log							
Project: Network Upgrade Project						**Date:** 04/01/20xx	
Change No.	**Change Type**	**Description of Change**	**Requestor**	**Date Submitted**	**Date Approved**	**Status**	**Comments**
CR001	Design/Scope	The change request calls for replacing existing Asus routers with Cisco routers.	R. Smith	3/25/2017	N/A	Denied	This request was denied by the change control board because adequate funding is not available for the purchase of new routers, and because the request is outside the project's scope.
CR002	Schedule	This change request calls for delaying the existing schedule by one week to ensure that all applications are backed up, which was not considered in the original project plan.	S. Black	3/26/2017	04/10/2017	Approved	This request was approved to ensure the security and continuity of all applications. One week will be added to the project schedule, and the project manager will communicate the impact of this change to all stakeholders.
CR003	Design/Scope	This change request calls for modifying existing network firewalls to add intrusion-detection systems to enhance network security.	M. Reed	3/27/2017	N/A	Deferred	This request was deferred and is pending a determination of the impact to the project's costs, schedule, and scope.

Figure 10-1 Example of a Change Log

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Changes may be requested for a variety of reasons, such as corrective actions, preventive actions, and repairs.

NOTE For details on the formal process for handling changes within a project, see Chapter 11, "Change Control."

Once the change is requested, the change control board (CCB), which usually consists of the project manager and other project team members as stated in the change management plan, meets to review the change request and decide whether to approve or reject the change. The disposition of the change request should be updated in the change log, and all approved change requests should be implemented by the appropriate project team member(s). The project manager, project team members, CCB members, and project sponsor will need to have access to the change log. The change may require updating appropriate project management plan components and project documents. If baseline changes are necessary, these changes should show only the changes from the current time going forward. Depending on which project components are affected, changes will need to be communicated with the appropriate personnel.

The project manager needs to control certain changes, including schedule changes, stakeholder changes, resource changes, and budget changes. No matter which type of change occurs, the project manager is responsible for ensuring that the change is properly documented and communicated to the appropriate project entities.



Schedule Changes

Schedule changes include any change requests that affect the project schedule, such as task delays, inaccurate task estimates, and procurement delays. When a schedule change has been approved, the project schedule baseline will need to be updated and milestones may have to be moved.

EXAMPLE: A project team member determines that several tasks are going to take longer than originally planned. Once the schedule change is approved by the CCB, the schedule baseline will need to be updated to reflect the new task durations for the affected tasks. This change would also affect any dependent tasks.

The project sponsor, project stakeholders, and project team members need to be notified each time schedule changes occur.



Stakeholder Changes

Stakeholder changes that occur in a project are of two different varieties. First, stakeholders, like project team members, may be removed from or added to a project. Second, stakeholders may make change requests that affect project scope, time, cost, quality, or procurements. When a stakeholder change has been approved, the appropriate project documents need to be updated.

EXAMPLE: A project stakeholder has left the company and been replaced by another stakeholder. In this case, the project manager will need to edit the stakeholder register and stakeholder management plan. The project sponsor and project team members will need to be notified about these changes.

EXAMPLE: A stakeholder has contacted the project manager to ask for a new requirement to be added to the project. This change request would need to be analyzed by the CCB. If approved, the change would need to be reflected in the requirements management plan. In addition, depending on the effects of the change, the project manager may need to update the cost baseline and/or schedule baseline. The project sponsor, project stakeholders, and project team members will need to be notified regarding the requested changes, even if they are not approved. This ensures that the requestor understands the change request resolution and the team members know not to implement the change request, even if requested privately at a later date.

EXAMPLE: A project team works from multiple locations, and team members often communicate with each other only via weekly project status video conferences. A project stakeholder requests a feature change in a new application that the team is developing. During the formal change control process, the change is denied. The next week, the stakeholder mentions the requested change during a call with one of the application developers. After the call, the developer decides that including this feature really would not add to the schedule, and she implements the code that would allow it. If the project manager had shared the change log with the entire team, all team members (including the application developers) would know that the change request was denied.



Resource Changes

Resource changes consist of any changes to project resources, such as changes in supplies, procurements, and personnel resources. When a resource change has been approved, the resource calendar, project schedule, schedule baseline, and other documents may need to be updated. If the resource change is related to personnel, the project manager should notify the project team and stakeholders. If the resource

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change is related to supply or procurement, the project manager only needs to notify the team members who are affected by the resource, and then only if the change affects project tasks.

EXAMPLE: A project team member must take an unexpected leave of absence, and a replacement team member has been allocated to the project. Tasks assigned to the original team member are reassigned to the new team member. If the new team member can complete work at the same speed as the original team member, the only update would be the resource assigned to the task. However, if the new team member completes work at a different speed, the task durations for the tasks assigned to the new team member will have to be adjusted, which also affects any dependent tasks. The project sponsor, project stakeholders, and project team members need to be notified that schedule changes have occurred.

EXAMPLE: A bulldozer has been allocated to complete the grading for a construction project. However, that particular machine is scheduled for repair during the five-day task for which the bulldozer will be needed. The project manager has two options: Delay the task that involves the bulldozer, or rent another bulldozer to prevent schedule delays. A task delay would require adjusting the schedule baseline, updating the team member who is responsible for the bulldozer, and notifying any team members who are responsible for dependent tasks. Renting another bulldozer would require adjusting the cost baseline, updating the project schedule to allocate the new bulldozer to the task, and informing the project sponsor of the budget change.



Budget Changes

Budget changes require decreases or increases in the project budget. A budget change may consist of increased procurement costs, decreased project team costs, increased task durations that affect project cost, decreases in the budget from the project sponsor, and so on. When a budget change has been approved, the cost baseline, project budget, and the cost management plan may need to be updated.

EXAMPLE: A project procurement is encountering higher costs than were originally estimated based on the vendor proposals. Once the CCB approves this budget change, the project manager would need to update the cost baseline, project budget, cost management plan, and procurement management plan.

Budget changes need to be communicated to the project sponsor and to stakeholders that want to be kept informed of the budget status. It is probably not necessary to share budget changes with all project team members, but project team members who have budgetary or procurement roles should be informed.

Risk Register Updates

The risk register includes all the identified positive and negative project risks. Events that may affect the risk register include changing the responsible party, changing a risk's status, and adding newly discovered risks. When the change has been approved, the risk register should be updated with the new information.

TIP A risk only becomes important if it happens. A newly identified risk is just acknowledged, analyzed, and documented.

EXAMPLE: The party responsible for a risk is leaving the project. Once the new responsible party is identified, the former responsible person's name should be removed and the new person added. If a new risk has been discovered, it will need to be thoroughly analyzed and added to the risk register so that a risk response can be planned. The changes to the risk register and the risk response plan would then need to be communicated to the project's sponsor, team members, and stakeholders.

No matter which type of risk register update occurs, it is the responsibility of the project manager to ensure that the change is properly documented and communicated to the appropriate project entities.

Milestones

As covered in Chapter 4, "Project Schedules," a milestone is a significant project event indicating that a phase of the project work is complete. Even though milestones do not actually have their own durations, the project's sponsor, stakeholders, and team members should be notified when milestones are met, missed, or moved so that all parties have a realistic view of the project's status. For example, if the first 20% of work on a project should bring the project to its first milestone, the project manager must report on that milestone once the schedule shows that 20% of the work is done. Reporting whether the milestone was met (hit on time), exceeded (hit early), or missed (not yet hit) gives valuable insight into how well the project is performing.

Milestones are included at a high level in the project charter and are part of the project schedule. Milestones should be noted on the project schedule so that the project manager will know when to report the achievement (or failure) of a project milestone. If scheduled tasks slip, milestone dates may need to be adjusted.

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Task Initiation/Completion

Throughout the project's life cycle, task relationships control the initiation and completion of tasks as part of the project schedule. When two or more project tasks share a dependency or logical relationship, a *predecessor* activity comes before any dependent activities, and a *successor* activity comes after the activity on which it is dependent.

Project task relationships are defined in one of four ways:

- **Finish-to-start (FS):** The predecessor activity must finish for the successor activity to start.
- **Finish-to-finish (FF):** The predecessor activity must finish for the successor activity to finish.
- **Start-to-start (SS):** The predecessor activity must start for the successor activity to start.
- **Start-to-finish (SF):** The predecessor activity must start for the successor activity to finish.

The FS relationship is the most common relationship in most projects.

Because many project tasks may involve different project team members, it is important to ensure that the project team is notified when tasks start and finish. The completion of a task should always be a communication trigger. Notification ensures that team members who are working on dependent successor tasks can start their tasks on time.

It is important to start and finish tasks on the critical path on time, in order to prevent project delays. Monitor those particular tasks closely.

NOTE Chapter 4 discusses how to determine the project's critical path.

No matter whether tasks are starting or finishing, and whether or not they are on the critical path, the project manager is responsible for ensuring that each task's initiation and completion are properly documented and communicated to the appropriate project entities.

Gate Reviews

To understand gate reviews, project managers must first understand the *phase-gate model*, also known as *phase-gate process* or *stage-gate process*. Most projects consist of a single pass through all of the project life cycle processes. In a phase-gate project,

an initiative or project is divided into stages or phases, separated by gates. Each gate completes that phase of the project life cycle and then undergoes review before the project moves on to the next phase.

EXAMPLE: A large, multi-story construction project uses a phase-gate process to subdivide processes into individual gates to ensure project management success. Each separate facet is its own project that runs through the phases, with gate reviews occurring as each portion is finished. The site preparation is one project gate, the concrete work is another project gate, the steel work is another project gate, and so on. In this manner, the overall project is more manageable, with each project manager being responsible for only his or her individual gate.

In projects with a phase-gate design, individual gates have relationships similar to the task relationships discussed earlier. *Gate reviews* are completed as detailed on the project schedule to clear the project to continue. At a gate review, the project managers and project sponsor meet to determine whether to continue the project. Gate quality-control checks are also performed at this time. Project sponsors make go/kill decisions based on criteria defined during the Planning phase of each gate.

The project manager is responsible for ensuring that the appropriate entities are aware of the gate review and participate in gate review meetings as necessary. In most projects, gate reviews are the sole responsibility of the project sponsor, with project managers participating to provide project details should questions arise. Once a project gate review is complete, the project manager must ensure that the gate review is documented and communicated with the appropriate project entities, usually the project stakeholders and project managers of the other gates.



Incident Responses and Business Continuity Responses

An *incident* is an event in a project that could lead to a disruption in the project. If not properly managed, an incident can escalate into an emergency, a crisis, or a disaster. *Incident management* is the process of limiting how much an event can disrupt a project.

Business continuity is the capability of a project to continue at acceptable levels following a disruptive incident. Most disruptive incidents for a project should be anticipated and documented during risk planning, and all documented risks should have a planned risk response. If an incident occurs, the project manager should first consult the risk management plan to see whether the incident was anticipated. If not, the project manager will need to work quickly with project team members to determine a business continuity response.

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EXAMPLE: A power outage occurs at a building site. If this risk was anticipated, the risk planning for the project would have ensured that an alternate power source, such as a generator, would be available. If the risk was not anticipated, the project manager may need to obtain an alternate power source. If no other power source is available, stopping project tasks at the construction site temporarily may be necessary until power can be restored.

Business continuity might require including plans for contacting civil authorities and informing the public. In some cases, the organization might need to notify dependent organizations, such as when a cloud deployment is a victim of an attack. The point is to anticipate such events and have a plan in place in case the event occurs. Nothing is worse than a security incident or some other event that leaves the project team not knowing what to do because nobody made a plan.

EXAMPLE: An application development project relies on a central server to store developed code, and a hard drive on that server crashes. If this risk was anticipated, the risk planning probably would have ensured that some sort of fault tolerance was implemented on the server and that data backups were completed. If the risk was not anticipated, the data on the failed drive must be recovered. Either case will involve some downtime until the data can be restored. During this server downtime, project team members could work on project tasks that do not require that server resource. The project manager will need to communicate schedule changes to the project stakeholders and team. Any data that is lost should be documented, and the documentation should be provided to the team members so that they can look for copies on their local computers. Finally, the project manager will need to communicate with the project stakeholders and team members about which parts of the project were affected by the server crash.

Whether or not business continuity response was part of the risk management plan, the project manager is responsible for ensuring that the project's sponsor, stakeholders, and team members are notified of the incident, the business continuity response, and the expected downtime. It may be necessary to postpone project tasks until the response is complete and operations return to normal.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 10-3 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 10-3 Key Topics for Chapter 10

Key Topic Element	Description	Page Number
Section; list; example	How *audits* trigger project communications	199
Section; Table 10-2	Target audiences for communications about project management plan components	200
Section; Figure 10-1	How *project changes* trigger project communications	201
Section; example	How *schedule changes* trigger project communications	203
Section; examples	How *stakeholder changes* trigger project communications	204
Section; examples	How *resource changes* trigger project communications	204
Section; example	How *budget changes* trigger project communications	205
Section; list	How *predecessor* and *successor* task relationships trigger project communications	207
Section; example	Overview of the *phase-gate model* process and *gate reviews* as project communication triggers	207
Section; examples	Overview of *incident responses* and *business continuity responses* as project communication triggers	208

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

audit, change request, change log, predecessor activity, successor activity, finish-to-start (FS) relationship, finish-to-finish (FF) relationship, start-to-start (SS) relationship, start-to-finish (SF) relationship, phase-gate model, gate review, incident, incident management, business continuity

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Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. You have been hired to take over as project manager for a new research project. You need to assess the project to ensure that it is complying with project requirements and quality metrics. What should you do?
   a. Place a formal change request.
   b. Perform a gate review.
   c. Update the risk register.
   d. Perform a project audit.

2. Which of the following communication triggers might require communication with a project vendor?
   a. audit
   b. procurement change request
   c. budget change request
   d. risk register update

3. For your company's current project, the project manager discovers that creating the project deliverables is taking significantly longer than estimated. After discussing this issue with the project sponsor, a new team member is hired. Which project communication trigger will most likely occur as a result of these actions?
   a. gate review
   b. audit
   c. stakeholder change
   d. budget change

4. Which of the following is an example of a stakeholder change?
   a. new project requirement
   b. increase in procurement cost
   c. gate review
   d. milestone completion

5. For a new printing project, the project sponsor requests upgrading to a higher-quality vinyl that is not currently in stock. You submit a change request. Which project entity must approve this change before it is communicated to the project team?
   a. project manager
   b. project stakeholders
   c. project sponsor
   d. CCB

6. Which communication trigger occurs when a procurement contract is for a higher dollar amount than estimated?
   a. schedule change
   b. stakeholder change
   c. budget change
   d. resource change

7. You are the project manager for a new construction project. During project planning, you learn that a backhoe owned by the project sponsor can be used for the project. However, two days before you need the backhoe, you find out that it is being repaired, and you must rent a backhoe instead. The backhoe rental is approved. Which communication triggers will be affected? (Choose two.)
   a. resource changes
   b. schedule changes
   c. budget changes
   d. stakeholder changes

8. Which project entities should most likely receive communications regarding the completion of a task C1 that has a start-to-finish (SF) relationship with task C2?
   a. the project team member(s) responsible for task C2
   b. the project team member(s) responsible for task C1
   c. the project stakeholders
   d. the project sponsor

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9. Which of the following describes a gate review?
   - **a.** a significant event that is part of the project schedule but does not actually have a duration
   - **b.** a meeting held to determine whether a project will continue
   - **c.** the process of verifying compliance with the project guidelines and validating the performance of the project
   - **d.** an event in a project that could lead to a disruption in the project

10. Which communication trigger often results in a business continuity response?
   - **a.** milestone
   - **b.** audit
   - **c.** incident
   - **d.** gate review



This chapter covers the following topics:

- **Understand the project change control process:** Identify and document the change, evaluate its impact and justification, identify the approval authority and obtain approval, implement the change, validate the change and check the project quality, update relevant documents, communicate about the change, and develop a regression plan.
- **Understand project change types:** Schedule change, budget change, risk event, requirements change, quality change, resource change, and scope change.
- **Understand organizational change:** Business merger/acquisition, business demerger/split, business process change, internal reorganization, relocation, and outsourcing.

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Change Control

Project changes occur when a project team member, stakeholder, or sponsor requests a modification in some documented facet of the project, such as its scope, schedule, or budget. Changes are inevitable and occur for a variety of reasons. When a change request is approved, it alters the course of the project, which in turn makes working within the scope, schedule, and budget constraints more challenging. For this reason, it is important for the project team and stakeholders to follow a formal change control process.

This chapter thoroughly explains the change control process, the types of project change, and the organizational changes that can affect projects. Changes as well as formal change control occur in the Monitoring and Controlling phase of a project.

This chapter covers the following objectives for the Project+ exam:

3.4 Given a scenario, use the following change control process within the context of a project.

3.5 Recognize types of organizational change.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 11-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 11-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Change Control Process	1–3
Project Change Types	4–7
Organizational Changes	8–10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. What is the first step in the change control process?
   a. Identify the approval authority and obtain approval.
   b. Develop a regression plan.
   c. Evaluate the impact of the change and provide justification.
   d. Identify and document the change.

2. Which entity is most likely to be the approval authority for a change request?
   a. project team members
   b. project stakeholders
   c. change control board
   d. project manager

3. What is the purpose of a regression plan?
   a. ensuring that the project sponsor understands the change
   b. ensuring that the change can be rolled back
   c. ensuring that all team members affected by the change are documented
   d. ensuring that all steps required for the change are documented

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4. A project task is going to take longer than originally estimated. What type of change request should be initiated?
   a. schedule change
   b. budget change
   c. risk event
   d. requirements change

5. A project team member received a merit increase that results in a higher hourly pay rate. What type of change request should be initiated?
   a. risk event
   b. schedule change
   c. resource change
   d. budget change

6. You learn that the lab needed for the project you manage will not be available during the originally planned time. However, you had anticipated this possibility and made alternative plans to complete the task at a later date. Which of the following occurred?
   a. budget change
   b. resource change
   c. risk event
   d. schedule change

7. A piece of equipment allocated to complete a project task is unavailable. What type of change request should be initiated?
   a. schedule change
   b. resource change
   c. budget change
   d. procurement change

8. Your company has decided to purchase a competitor to obtain its intellectual property and business contacts. Which type of organizational change is this?
   a. business acquisition
   b. business split
   c. internal reorganization
   d. outsourcing

9. While you are managing a project, your company announces that the sales and marketing departments will be merged into a single department. Of which organizational change is this an example?
   a. business merger
   b. relocation
   c. business process change
   d. internal reorganization

10. While you are managing a project, your company decides that all purchases over $25,000 must go through a formal approval process that involves three members of upper management. Your project plans to make multiple purchases over this amount. Of which organizational change is this an example?
   a. outsourcing
   b. business split
   c. business process change
   d. business merger

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Foundation Topics

Change Control Process

Key Topic

The *change control process* for a project is a formal procedure for reviewing all change requests, approving changes, managing the changes, and communicating how they will affect the project. The project's *change control board (CCB)* is the group of individuals who are responsible for reviewing every requested project change and approving or rejecting the request. In smaller organizations, the CCB might include only the project manager and project sponsor, but a formal CCB still must be established. The change control process is the ultimate responsibility of the project manager, although other project entities may be part of the approval or rejection process.

NOTE If the CCB is considering deferring a request, the usual response is to give a conditional approval. ("If a certain thing happens, we will approve this change. If not, the change will not be implemented.") The only person who can overrule the CCB is the project sponsor, which rarely happens because the CCB usually includes the project sponsor or someone from the sponsoring organization with expert knowledge regarding the reasons behind approving or denying changes.

The change control process consists of a series of steps:

1. Identify and document the change.
2. Evaluate the impact of the change and provide justification for it.
    a. Develop a regression plan in case the change needs to be reversed.
3. Identify the change approval authority.
4. Obtain approval for the change.
5. Implement the change.
6. Validate the change and check how it affects project quality.
7. Update project documents, audit the project, and implement version control.

In addition, the project manager should communicate information about the changes as needed throughout the change control process.

NOTE The phrasing of these steps may differ slightly between the Project+ exam and other common standards, such at the Project Management Book of Knowledge (PMBOK). In most cases, the author has chosen to use the wording of the standards rather than CompTIA's wording.

Identify and Document the Change

A change request is a formal proposal to modify any document, deliverable, or baseline in the project. The following types of change requests are typical for most projects:

- Schedule changes
- Budget changes
- Risk events
- Requirements changes
- Quality changes (including defects/corrective actions)
- Resource changes
- Scope changes
- Communication changes
- Stakeholder changes
- Procurement changes
- Organizational changes

A formal change request template should be adopted for every project. Figure 11-1 shows an example of a change request template.

Although the information recorded in the change request may vary based on the project and any applicable organizational standards, the change request form should contain at minimum the following components:

- Change request date
- Change control identifier (ID)
- Name of change requestor
- Name of change owner
- Details of proposed change

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- Results and estimates of change analysis, including any effects to scope, schedule, and/or budget
- Sign-off from project manager after analysis
- Sign-off from CCB after approval/denial
- Sign-off from project sponsor

Change Request Form (Example)

This form is divided into three sections. Section 1 is intended for use by the individual submitting the change request. Section 2 is intended for use by the Project Manager to document/communicate their initial impact analysis of the requested change. Section 3 is intended for use by the Change Control Board (CCB) to document their final decision regarding the requested change.

1) Submitter—General Information				
CR#	*CR001*			
Type of CR	☐ Enhancement	☐ Defect		
Project/Program/Initiative				
Submitter Name	*John Doe*			
Brief Description of Request	*Enter a detailed description of the change being requested.*			
Date Submitted	*mm/dd/yyyy*			
Date Required	*mm/dd/yyyy*			
Priority	☐ Low	☐ Medium	☐ High	☐ Mandatory
Reason for Change	*Enter a detailed description of why the change is being requested.*			
Other Artifacts Impacted	*List other artifacts affected by this change.*			
Assumptions and Notes	*Document assumptions or comments regarding the requested change.*			
Comments	*Enter additional comments.*			
Attachments or References	☐ Yes	☐ No		
	Link:			
Approval Signature	*Approval Signature*		Date Signed	*mm/dd/yyyy*

2) Project Manager—Initial Analysis				
Hour Impact	*#hrs*	*Enter the hour impact of the requested change.*		
Duration Impact	*#days*	*Enter the duration impact of the requested change.*		
Schedule Impact	*WBS*	*Detail the impact this change may have on schedules.*		
Cost Impact	*Cost*	*Detail the impact this change may have on cost.*		
Comments	*Enter additional comments.*			
Recommendations	*Enter recommendations regarding the requested change.*			
Approval Signature	*Approval Signature*		Date Signed	*mm/dd/yyyy*

3) Change Control Board—Decision				
Decision	☐ Approved	☐ Approved with Conditions	☐ Rejected	☐ More Info
Decision Date	*mm/dd/yyyy*			
Decision Explanation	*Document the CCB's decision.*			
Conditions	*Document any conditions imposed by the CCB.*			
Approval Signature	*Approval Signature*		Date Signed	*mm/dd/yyyy*

Figure 11-1 Part of a Change Request Template

Evaluate Impact and Provide Justification

Once the formal change request is submitted, the project manager or other designated party should evaluate the impact of the requested change on the project and provide justification for making the change. First, the project manager must determine the effort needed to implement the change. A change might affect the project's scope, schedule, budget, quality, resources, risks, communication, procurements, and/or stakeholders. To evaluate the change, the project manager should use expert judgment and analysis from subject matter experts and team members with expertise in the area of the requested change to identify all the project components affected by the change. Once the potential effects are documented, the project manager will need to provide justification for the change. As part of evaluating the impact and providing justification, the project manager will also need to develop a regression plan.

Develop a Regression Plan

In some cases, even after a change is evaluated and approved, it may be necessary to return to the project state prior to the incorporation of the change. For this reason, the project manager creates a *regression plan*, which details the process whereby an approved change can be reversed.

EXAMPLE: A jewelry company is developing a new mobile application that will allow customers to design custom jewelry pieces. The first release of the application will only allow for designing rings, but later other jewelry items will be added as separate modules. Initially the application creates a final design image that the customer can take to one of the company's stores, which will create the mold for the specified piece. The ability to order and purchase custom jewelry directly from this application will not be added until the very end of the project. As the project adds new modules to the application, it also needs the ability to remove a module if it causes problems with the overall function of the application or with another module. The software development team should create a regression plan to ensure that modules can be rolled back quickly.

Identify Approval Authority and Obtain Approval

After assessing the impact of the requested change and establishing its justification, the project manager must identify the approval authority for the change. In most projects, the CCB is responsible for approving or rejecting requested changes during change control meetings. The CCB may also document and review the process for making a change. If the project sponsor is not a member of the CCB, the project manager probably will need to obtain project sponsor approval as well, especially if the change affects the project's scope, schedule, or budget. At this point, the project

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manager needs to make sure that the change log reflects the requested change and its disposition. Stakeholder communication regarding the project change is also essential at this stage.

NOTE For an example of a change log, see Chapter 10, "Communication Triggers and Target Audiences."

Implement Change

After the change is approved, it can be implemented in the project. The project manager should communicate with the project team members to ensure that they understand how the change will be implemented and how it will affect the project's scope, budget, and scheduling. The ultimate effects of the change depend on the type of change being implemented. (Change types are discussed later in this chapter.)

Validate Change and Check Quality

Next, the project manager uses change validation to confirm that the change was implemented. During change validation, the project manager should also perform quality assurance to ensure that the change did not have a negative effect on project quality standards. If the change negatively affected the project's deliverables or quality standards, the project manager implements the regression plan to return the project to its previous state.

EXAMPLE: A jewelry company's mobile application lets users design custom rings, earrings, bracelets, and necklaces. The application currently creates an image of the completed design, which the customer must take to one of the company's stores to order the final product. A new module for the app would allow the customer to locate and contact one of the company's stores to submit the order electronically. However, when the new module is tested, the algorithm that should select the closest store does not seem to be working properly. The project team should use the regression plan to roll back the latest module and fix it before deployment.

Update Documents

Once validation is complete, the project manager must ensure that the project management documentation has been updated, including the baselines and subsidiary plans of the project management plan. The project manager should also perform a project audit at this point to determine whether the project is on track. In some cases, internal or external auditors may be necessary to maintain independence.

Once the audit is complete, its results should be documented and communicated with the project sponsor, stakeholders, and team.

Keep in mind that at this point the project has probably produced multiple versions of some project documentation. It is critical that project managers implement version control for all documentation. In most cases, this includes using version numbers as well as providing a chronological listing at the beginning or end of each document, detailing changes that have taken place. Some organizations take this tracking a step further and retain all versions of product documentation.

Change Communication

Communication is vital to ensure that every change is understood by the project sponsor, stakeholders, and team members. The project manager should ensure that the appropriate change communication occurs throughout the change control process. This is necessary for all change requests, whether they are ultimately accepted or rejected.

EXAMPLE: A project is remodeling a building, and the CCB approves an adjustment in the location of the building's bathrooms. The project manager needs to communicate this change during the regular team meetings. This change also must be communicated to anyone who does not attend those meetings, via the recipient's preferred method of communication. In most cases, the project manager should obtain some sort of proof of notification or formal sign-off from team members, stakeholders, and sponsors to ensure that everyone understands and acknowledges the change.

Project Change Types

Project managers must fully analyze and understand all project changes. Changes commonly occur in all aspects of most projects, including the project's schedule, budget, risks, requirements, quality, resources, scope, communication, stakeholders, and procurements. The following sections discuss and provide examples of all of these change types and how they might affect a project.

NOTE Although CompTIA does not specifically list it in the objectives, emergency changes happen in many projects, and the project manager should be prepared to handle such situations. The "Emergency Changes" section discusses such changes and how they might affect the project's change control.

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Regardless of the type of change, the project manager must fully analyze the change's potential effects on the project's scope, schedule, budget, and so on. If other project team members or stakeholders are affected, the project manager needs to consult them to gain their input on the change. Each of the following sections notes ways in which that specific type of project change is addressed.

NOTE Regardless of the type of change, the project manager must follow the change control procedure discussed earlier.

Key Topic

Schedule Changes

Because schedules are predictive approximations, project schedules are likely to change. Schedule accuracy should be evaluated regularly by the project manager and communicated to project stakeholders. When schedule changes are requested, the project manager should assess their effect on other aspects of the project and inform the project team, stakeholders, and sponsor of the impact.

Schedule changes include task shortening and lengthening, task additions and deletions, task assignment changes, and task delay. If the affected tasks are on the critical path, the overall schedule will be affected by the change. However, if an affected task is not on the critical path, the task may have enough float or slack that the change will not affect the overall amount of time needed to complete the project. Normal schedule changes that are accounted for by slack and float do *not* have to go through formal change control. However, the schedule will need to be updated to ensure that any changes to the float and slack for dependent tasks are adjusted.

NOTE For more information on critical path and float, see Chapter 4, "Project Schedules."

If a task is shortened or deleted, the budget is likely to decrease. If a task is lengthened or added, the budget is likely to increase. If a task assignment changes, the budget may increase or decrease, depending on the cost of the new task resource. If a task is delayed for any reason, its dependent tasks will be delayed. The entire project could be delayed if the task is on the critical path.

Figure 11-2 shows a critical path grid. In this example, if tasks A, F, K, N, or P are delayed, the project itself will be delayed because these tasks form the critical path. However, if tasks C, H, L, O, and P are delayed no more than two days, the overall product will not be delayed because the float for path C–H–L–O–P is two days.

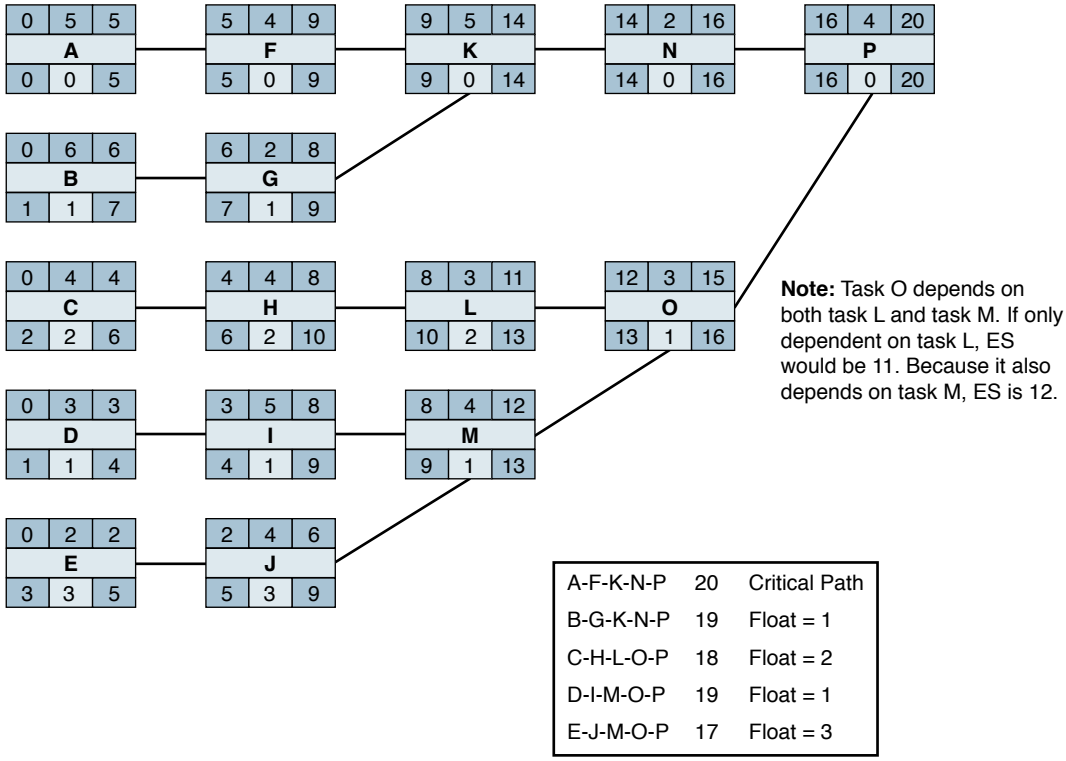


Figure 11-2 Example of a Critical Path Grid

EXAMPLE: A project manager is notified of a delay in the shipment of the cabinetry needed for a new home construction project. Many of the project's tasks can continue without being affected by the cabinetry delay. However, the kitchen and bathrooms cannot be completed until the cabinetry is installed. The project manager will need to adjust dependent tasks (counter installation, sink installation, and appliance installation) for the shipment delay. All of these steps are part of the original schedule change. This type of schedule change could result in a budget increase if the original installers will not be available for the delayed delivery date and the new installers have a higher rate of pay. Similar cost adjustments may be necessary for any other dependent tasks. If the adjusted costs are known at the time of the original schedule change, then those changes should be approved as well, thereby ensuring that the effects on the project constraints are approved.

When a change such as this occurs, the project manager should meet with the project team members responsible for the dependent tasks, to gain their input on the

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effects of the change. Getting team member feedback will often ensure that nothing is forgotten or omitted from consideration.

TIP When the CCB analyzes a change, its affects on all constraints are examined and documented. Approving the change therefore includes approving any reliant changes. Suppose a schedule change is approved, and it is documented that this schedule change will result in the need to pay a different resource at a higher rate of pay because the original resource will not be available. This reliant resource change is automatically approved during the schedule change approval. Now suppose the schedule change is approved, but the project manager learns *later* that the original resource is not available. In that case, the resource change requires a separate change request.

Key Topic

Budget Changes

Like project schedules, project budgets are predictive approximations of project costs, and therefore are likely to change. Budget accuracy should be evaluated regularly by the project manager and communicated to project stakeholders. When a budget change is requested, the project manager should assess its effect on other aspects of the project, informing the project team, stakeholders, and sponsor of the impacts of the proposed change.

Budget changes include increases or decreases in task costs, resource costs, and procurement costs. An increase in costs in one area may require trimming costs in other areas. A decrease in costs may result in leftover budget amounts to apply to other costs. Budget changes may result in adjustments in project scope or in the project schedule.

EXAMPLE: A project manager is notified that all the bids for the new software needed for a large library remodel project are higher than originally estimated. Of course, the project manager will need to adjust the project budget. If reducing the number of features in the requested software is not possible, the project manager may need to find other areas and ways to cut costs. Options may include purchasing lower-quality shelving units for the library, decreasing the number of computers being purchased, hiring fewer contractors for the building remodeling, and so on.

If a budget change results in higher costs, the project manager should meet with the project team members to gain their input on the effects of the higher costs and to discuss how to cut costs in other areas. If the budget change results in lower costs, the project manager should inform the project team but may not need input because leftover budget funds are held in reserve.



Risk Events

Project constraints can be affected by known risk events, but unknown risk events can also occur, and new risk events may be identified. If a risk was identified during the Planning phase, the budget should have contingency reserves allocated to cover the costs of responding to that risk if it occurs. The solution may be as simple as adjusting the appropriate project constraints (such as scope, budget, or schedule) to address the risk. Such cases may not require formal approval from the CCB, but the project manager would still need to communicate the change, update the project documents, and perform version control and auditing as usual. Known risks are often covered by management reserves allocated during project planning.

If a risk occurs that was not identified in the Planning phase, the project manager will need to address the effects of that risk event via the change control process. The steps include a full analysis of the effects of the risk, as discussed earlier.

EXAMPLE: Known risk: During its Planning phase, an environmental research project noted that weather events might delay or prevent the collection of the research data. The project manager has already built into the project schedule a certain number of float days to account for this known risk event. However, after a weather delay, one of the original project team members is unavailable for the new research dates. This situation would result in a change to the team member allocation for the research tasks. In addition, it may result in a change to the budget if using the new team member results in a different cost.

EXAMPLE: Unknown risk: A project team member requires medical leave unexpectedly. The project manager will need to analyze how losing this team member will affect the project schedule. It may be necessary to assign the team member's tasks to other project team members, which could result in delivery delays. If a schedule delay is not acceptable, the project manager may need to find a replacement for the team member. No matter what occurs, the project manager will need to determine how the project schedule and project budget are affected by this unknown risk event and complete the change control process accordingly.

EXAMPLE: New risk identified: A project team member notifies the project manager that the lab needed to perform certain tasks may not be available. The project manager should analyze the effects of this previously unidentified risk on the project schedule and project budget. Perhaps the task dates can be revised, or an alternate lab is available.

The risk register would need to be edited in any of these examples, whether a potential risk event was anticipated or a new risk is identified.

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Requirements Changes

Project requirements are analyzed and documented during the Initiating and Planning phases of the project, but new requirements often are identified during the Executing phase or the Monitoring and Controlling phase. Project requirements are specified by the project sponsor and project stakeholders. However, all of the given requirements might not actually be incorporated into the project. If a new project requirement is identified or a project requirement is removed, the project manager will need to analyze how this change will affect the project's scope, schedule, and budget.

A new requirement likely results in a change in the project scope and schedule as well as an increase in the project budget. Removing a requirement also changes the scope and schedule and likely decreases the project budget.

EXAMPLE: A project stakeholder asks the project manager to add a new feature to a software development project. The project manager will need to analyze the effects of this change on the project's schedule, budget, and scope. The project manager should meet with the project team members to gain their input on the effects of the new requirement. A new task or tasks will need to be added to the schedule to accommodate development of the new feature, and the project's budget will increase. If the new requirement is approved, the project scope will need to be expanded to include details about the new feature, and baselines will need to be adjusted.



Quality Changes

Quality is the level to which a project meets its specifications or meets the expectations of the project sponsor. Quality changes include defects and enhancements identified during quality control, resulting in change requests. Any change in scope, schedule, or budget can affect the quality of the project deliverables. The project manager must ensure that all quality measurements are documented as part of the quality management plan. Throughout the project's life cycle, project managers must ensure that quality assurance and control measures are completed.

Quality changes include changing parameters for deliverable quality, based on quality assurance and control measures or based on changes in requirements. Quality changes may affect the project's scope, budget, and schedule in a negative or positive manner, depending on the effort and resources needed to meet the new quality standards.

EXAMPLE: A plastics manufacturer is hired to produce a storage case for a new drone. During the Planning phase of the project, the drone manufacturer provided the plastics company and the project manager with very detailed case specifications,

including appearance, color, internal slot sizes, and external size. In testing the prototype run of 15 storage cases, the drone manufacturer determines that the plastic of the case is too weak to withstand drops without damaging the drone parts, and therefore requests a stronger plastic. The project manager will need to determine what effects this specification change will have on the project's scope, schedule, and budget. More than likely, the project manager will need to consult with the plastics manufacturer's management and the project team to determine the full impact of this quality change.

Key Topic

Resource Changes

A resource change is any change in material resources or personnel resources needed to complete a project:

- *Material resources* include any supplies that a project may need, such as construction equipment to complete a project for replacing the pavement on a city road. For material resource changes, the project manager may have to find alternative solutions or suppliers if an identified resource is not available. Material resource changes usually affect the project schedule and budget.

  EXAMPLE: A road paving project allocated a piece of equipment owned by the project sponsor to complete the road. Just before that equipment is needed, it is allocated to a higher-priority project. The project manager has a couple of options on how to resolve this issue. One option is to find a substitute resource, such as renting the necessary equipment from a rental company, but such a resource change would result in higher costs. The other option is to wait until the original equipment is available, which would result in a schedule delay.

- *Personnel resources* are the project team members who work to complete the project. For personnel resource changes, the project manager might attempt to find replacement team members or transfer essential tasks to existing team members. Personnel resource changes might affect the project schedule and budget, depending on the level of expertise or production and the rate of pay, respectively. Personnel resource changes can also affect project scope if a replacement resource is not capable of producing the same quality expected of the original resource.

  EXAMPLE: An artisan is a team member on a project to produce handmade home décor. Five weeks into the project, the artisan has to leave the project. The project manager must find some way to complete the tasks assigned to this personnel resource. She may decide to hire a new artisan or to transfer the work to another artisan on the team. Hiring a new artisan would allow the

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project to stay on schedule if the new team member is as skilled as the previous one. Also, the new artisan may require a different pay rate. Transferring the work would likely affect the project schedule and maybe the project budget. When considering personnel resource changes, the project manager must compare the resource's skill, knowledge level, and rate of pay with those of the team member who is being replaced.



Scope Changes

Project scope changes request an addition to or subtraction from the agreed-upon scope of work for a project. An addition to scope will likely require a corresponding increase in the project budget and additional tasks in the project schedule. A subtraction from scope will likely reduce the project budget and remove tasks from the project schedule. Either of these changes can affect the resources needed for the project.

EXAMPLE: A project is initiated to replace a company's current twisted-pair network with a fiber-optic network. In the original project, the new network would be implemented in three office buildings. However, halfway through the project, the project sponsor purchases a fourth building and requests that this office also be included in the project. In this case, the project manager will need to determine the cost of supplying the new building with a network and will have to obtain the material and personnel resources to deploy this fourth network. The overall project schedule and project scope will also have to be changed.

NOTE This example addresses a scope change; it is not a case of scope creep. Scope creep is covered in Chapter 7, "Project Constraints and Influences."



Communication Changes

Communication changes are usually not as detrimental to project constraints as some of the other changes discussed to this point. These changes usually involve altering the type of communication required for a particular stakeholder or a certain event. The project manager simply needs to document the change in the communication plan. In most cases, the communication change does not result in any budgetary, schedule, or scope changes, and it would not need to be documented in the change log or follow the formal change control process. A communication change would need to follow the formal change control process only if the request would affect the project constraints.

EXAMPLE: A stakeholder would like to start receiving project schedule reports. This change could be accomplished just by adding the stakeholder to the distribution list for this report.

EXAMPLE: A new stakeholder on a project does not have access to the software that the project team uses to share documents. Connecting the stakeholder to the rest of the team will require additional hardware, networking, and so on. This communication change affects the budget, and therefore must go through the formal change control process.

For any communication change, the project manager needs to make sure that project team members who send out the affected communications are notified of the change. These changes must be noted in the project's communication plan and implemented with version control.

Key Topic

Stakeholder Changes

Projects may experience two types of stakeholder changes. One situation is the addition or removal of a project stakeholder due to change of duties, hiring, firing, and so on. The other is through a change in the stakeholder requirements, which is technically a requirements change, as covered in the earlier "Requirements Changes" section.

Because stakeholders affect a project only through their influence and the project requirements they request, the project manager should ensure that any replacement, addition, or removal of a stakeholder is documented. Then the project manager should meet with the new stakeholder to ensure that he or she understands the project. The project manager also needs to document the stakeholder's requirements, which may not all have been incorporated into the project previously.

EXAMPLE: A new human resources manager is a stakeholder in a project to replace all computers in the human resources department. If the manager decides that video recording capability is important for all the computers, and this was not one of the original requirements, the project manager will need to evaluate the impact of this change to the project scope, schedule, and budget.

For any stakeholder change, the project manager needs to make sure that the project team members understand how the stakeholder change will affect communication and project scope.

Key Topic

Procurement Changes

Project procurements undergo a formal process whereby procurement requirements are documented, bids are solicited, vendors are selected, and then the actual procurements take place. Procurement changes can be requested at any time during this

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process by either project sponsors or procurement vendors. However, procurement changes are less likely to be granted once a procurement contract has been signed and procurement production/delivery is imminent.

EXAMPLE: A project manager realizes that an error was made in the specifications for a part required in a project to manufacture a new wireless device. If the invitation to bid (ITB) has already been issued, the project manager will need to issue an amendment to the ITB. However, if the project manager is already in negotiations with the selected vendor, he will need to amend the contract to document the specification change that has occurred. The selected vendor will need time to assess the effect of the change on the contract, including cost and schedule.

For any procurement change, the project manager will need to make sure that the procurement vendor and the project team members understand how the procurement change will affect the project, particularly the project schedule. If the procurement change will affect the procurement cost, the project sponsor may also need to be informed.

Key Topic

Emergency Changes

Emergency changes must be approved in a timely manner. These types of changes are needed to restore a service, prevent an incident, address a pressing need such as a legal requirement, and so on. If an emergency change is needed, the project manager should convene an emergency CCB meeting to discuss only the emergency change. Once approval is obtained, the project manager should walk the change through the remaining steps in the process to ensure that the change is implemented quickly.

EXAMPLE: A project team member discovers an error in an application that is being designed for public use. This error could result in a security issue that gives hackers access to personally identifiable information. The team member has identified the code that needs repair, but a portion of the application was already released for beta review, and it contains the security issue. The project manager should document how long it will take to fix the problem and immediately convene a CCB meeting to obtain approval for this emergency change.

For any emergency change, the project manager must make sure that the team members understand how the emergency change will affect the project, particularly the project schedule and budget.

Key Topic

Organizational Changes

Just as projects change, organizations also change. The hierarchy can change, altering the reporting structure of the business. Other organizational changes that can

affect projects include business mergers/acquisitions or demergers/splits, business process changes, internal reorganization, relocation, and outsourcing.

The following sections discuss these specific types of organizational changes and how they might affect a project. For every type of organizational change, the project manager must fully analyze the change to determine its potential effects on all aspects of the project, including scope, schedule, budget, resources, and so on. If other project team members or stakeholders might be affected, the project manager needs to consult them to gain their input on the change. Each of the following sections notes any differences in how that specific type of organizational change is handled.

Business Merger/Acquisition and Demerger/Split

Business mergers combine two organizations into one entity. Typically one of the businesses purchases the other as a *business acquisition*, or the two businesses join forces due to shared interests or to deepen market penetration. If the merger occurs through acquisition, the purchaser usually makes all the decisions on how the merger will occur and which assets will be retained after the merger is complete. Often an overlap of departments and job types means that departments may merge and personnel may be terminated or transferred because job role duplication is not necessary.

A business merger or acquisition could affect a project in several ways:

- New stakeholders and team members may be identified.
- The acquired company may have technologies or expertise that could affect the project's budget and schedule in positive ways.
- Similar projects may have already been undertaken by the other company.
- Other resources (such as necessary supplies, equipment, or other assets) may be shared with the project.

Business mergers or acquisitions usually have positive effects on the project.

A *business demerger* splits a business into separate entities. In this situation, management must determine how the split will affect the disposition of assets, including personnel. Shared resources, especially hardware assets, may be allocated to one of the new organizations. The other new organization then may need to replace or purchase assets to ensure that business processes can continue.

A business demerger or split could affect the project in multiple ways:

- Stakeholders and team members may be split off from the company retaining the project.

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- Technologies or expertise needed by the project may no longer be owned by the company retaining the project.
- Needed resources may be split off from the company retaining the project.
- The budgetary resources needed for the project may be gone.

Business demergers or splits usually have negative effects on the project.

No matter which type of corporate restructuring occurs, the project manager will need to analyze the effects of the restructure on all aspects of the project, including project scope, budget, schedule, resources, stakeholders, and communication. Editing the project documentation, particularly the budget and schedule, may take a bit of effort to ensure that the project can continue as originally planned.

Business Process Change

A business process change is usually implemented when an organization wants to improve performance, reduce costs, and/or increase profitability. Process changes may have dramatic results, but gauging the degree of change requires before-and-after performance measurements. Before implementing the process change, the organization should take baseline performance measurements of the process, which then can be compared to the performance measurements achieved after the change is implemented.

When any type of business process change affects a project, the project manager will need to analyze the effects of the change on all aspects of the project.

EXAMPLE: A company adopts new accounts payable procedures to pay invoices for goods in a more timely manner. Because this new process will affect several projects, the project manager for each project will need to document the change in the project's procurement management plan and any other affected areas of the project. Making this update will help to ensure that the project team members follow the appropriate procedures for accounts payable.

Internal Reorganization

An internal reorganization is an overhaul of a company's internal structure and may involve some or all of the company's departments. Companies reorganize to improve efficiency, cut costs, reposition the business, and/or deal with corporate changes such as mergers and acquisitions.

EXAMPLE: An organization has a team of IT technicians at each office location. The company decides to go to a shared-services model in which most IT services are handled by a single team at a central location. For most day-to-day operations,

this model may be sufficient, but complex issues may result in a delay in recovery or resolution. The project manager will need to analyze the effects of this internal reorganization on the project. If the project has a high priority and will have IT requests outside the norm, it may be necessary to have an IT technician on location as a project team member. This organizational change would definitely affect project costs but would also ensure that any issues could be handled quickly.

Relocation

When all or part of a company relocates from one place or facility to another, all of the business assets must be moved from the original location to the new one. For IT assets, the systems must be brought back online and necessary services restored as quickly as possible. Some business assets will have a lower priority than others in the restoration process. The project manager will need to analyze the effects of the relocation on all aspects of the project.

EXAMPLE: An organization is moving its entire operation across town to a new facility. The actual moving of the assets can take place after normal business hours, but not all assets will be operational the next morning. The project manager will need to identify the assets that are vital to the project and ensure that those assets are restored to full operation as quickly as possible.

Outsourcing

When business processes are contracted to entities outside the organization, this *outsourcing* may provide cost benefits. However, outsourcing can adversely affect schedules because the contracted workers are not under the direct control of the organization. Some sources provide work for multiple organizations, which may result in delays.

The project manager will need to analyze the effects of outsourcing on all aspects of the project, including project scope, budget, schedule, resources, stakeholders, and communication. The primary constraints affected by outsourcing are usually the project schedule and budget.

EXAMPLE: A music production company has a project to launch a new music application. The coding work for the project is outsourced to freelance software developers. The project manager will need to stay in constant communication with the contract developers to ensure that they stay on task and on schedule. The project manager may decide to pad the schedule to allow for missed deadlines.

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Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 11-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 11-2 Key Topics for Chapter 11

Key Topic Element	Description	Page Number
Sections; lists; steps; Figure 11-1; examples	Steps and activities in the *change control process*	219
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Section; example	Discussion and example of *stakeholder changes*	232
Section; example	Discussion and example of *procurement changes*	232
Section; example	Discussion and example of *emergency changes*	233
Sections; lists; examples	Discussion and examples of how *organizational changes* (mergers, splits, etc.), process changes, and relocations affect projects	233

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

change control process, change control board (CCB), regression plan, material resources, personnel resources, business merger, business acquisition, business demerger, outsourcing

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. A project team member has submitted a formal change request. As the project manager, what is the next step that you must perform?
   a. Develop the regression plan.
   b. Evaluate the impact of the change and provide justification.
   c. Identify the approval authority and obtain approval.
   d. Implement the change.

2. You need to make sure that a project can roll back a requested change. What should you create?
   a. change validation
   b. risk event
   c. regression plan
   d. change request

3. A project stakeholder has requested a project change. Which entity will approve or deny the request?
   a. project manager
   b. project team members
   c. project stakeholders
   d. change control board

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4. While working on a project task for a new application, a project team member realizes that another task has been omitted, and therefore an important part of the application will not have the appropriate security mechanisms in place. The operation being completed in the new task is part of the original project scope. As the project manager, you must assess any effects that adding the task will have on the project. What type of change has been requested?
   a. schedule change
   b. resource change
   c. requirements change
   d. scope change

5. You are the project manager on a new construction project. The lead carpenter contacts you to say that one type of lumber used on the project is out of stock at the primary supplier. A secondary supplier is already approved for this project, but the lumber is more expensive from this supplier. Which type of change has been requested?
   a. quality change
   b. requirements change
   c. schedule change
   d. budget change

6. You are the project manager for an environmental project that is researching the effects of local construction and retail development on water quality. After the project starts, the sponsor realizes that the testing will only occur during fall and winter. He decides that he wants the project to test during spring and summer as well. Which type of change has been requested?
   a. risk event
   b. budget change
   c. requirements change
   d. quality change

7. You are the project manager for a road repair project. Your project is scheduled to use the company's cement hauler tomorrow, but you have just learned that the equipment was damaged in an accident today. During project planning you were worried that such a situation might occur, and you included plans just in case essential equipment was unavailable for some reason. Which type of change has occurred?
   a. scope change
   b. risk event
   c. requirements change
   d. resource change

8. You are the project manager for a steel construction project. Just before construction begins, the customer requests that a higher-grade steel be used. Which type of change request has occurred?
   a. quality change
   b. resource change
   c. scope change
   d. procurement change

9. You are the project manager for a new wireless headset design project. This project requires several expensive purchases from third parties. Just before the procurement process starts, your company issues new procedures that must be followed for large purchases. These new procedures will affect half of the procurements of your project. Which organizational change has occurred?
   a. business merger
   b. business process change
   c. internal reorganization
   d. outsourcing

10. Which of the following is an example of internal reorganization?
    a. A software development company decides to use third parties to complete some unfulfilled development projects.
    b. Management decides to move a branch office from one city to another.
    c. A company splits the sales and marketing personnel into two different teams, each reporting to a different supervisor.
    d. Management decides to sell an application the company owns that is no longer profitable.

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This chapter covers the following topics:

- **Understand project management tools:** Tools include project scheduling software, charts, dashboards and status reports, knowledge management tools, performance measurement tools, SWOT analysis, and RACI matrixes.

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Project Management Tools

Today, sophisticated tools can help with the many details of project management. Each type of tool described in this chapter fulfills specific needs within the project, such as predicting scheduling conflicts, analyzing task performance, or graphically depicting quality issues. The project manager should fully research features and select the best available tools for the job. Some project managers may have to work with the tools available from or dictated by their organization or project management office (PMO).

This chapter covers the following objective for the Project+ exam:

4.1. Compare and contrast various project management tools.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 12-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 12-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Project Scheduling Software	1
Charts and Diagrams	2–3, 10
Dashboards and Status Reports	4
Knowledge Management Tools	5
Performance Measurement Tools	6, 9
SWOT Analysis	7
RACI Matrix	8

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which project tool is used mainly to track project activities, their durations, and the personnel assigned to them?
   - **a.** process diagram
   - **b.** histogram
   - **c.** fishbone
   - **d.** project scheduling software

2. What is the purpose of a histogram?
   - **a.** setting priorities
   - **b.** categorizing the potential causes of a problem to identify root causes
   - **c.** depicting the approximate distribution of statistical data
   - **d.** depicting the steps in a business process in sequential order

3. Which project chart is used to find a correlation between two variables?
   - **a.** run chart
   - **b.** scatter chart
   - **c.** Pareto chart
   - **d.** Gantt chart

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4. Which of the following answers *best* states the purpose of the project dashboard?
   a. providing the project status
   b. displaying project activities over time
   c. showing trends, variations, or declines/improvements in a project over time
   d. managing collaborative content

5. Which knowledge management tool provides project team members with answers to questions about third-party products?
   a. wiki pages
   b. vendor knowledge base
   c. intranet site
   d. collaboration tool
   e. dashboard

6. Which KPI is used to show the value a project has earned from the money spent to date?
   a. CPI
   b. AC
   c. PV
   d. EV

7. What is the purpose of a SWOT analysis?
   a. identifying risks
   b. identifying roles and responsibilities
   c. estimating costs
   d. breaking down activities

8. Which tool is used to determine the roles required to handle each project activity?
   a. SWOT analysis
   b. RACI matrix
   c. Pareto chart
   d. BSC

9. What categories are analyzed in a BSC?
   a. Planning, Initiating, Executing, Monitoring and Controlling, and Closing
   b. Responsible, Accountable, Consulted, and Informed
   c. Missed Milestones, Crossed Deadlines, and Resource Utilization
   d. Financial, Customer, Internal Process, and Learning and Growth

10. Which project tool helps the project manager identify the largest single source of problems in a project?
   a. histogram
   b. Gantt chart
   c. Pareto chart
   d. scatter chart
   e. fishbone diagram

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Foundation Topics

Key Topic

Project Scheduling Software

Having just the right tool can make the project manager's job much easier. Modern *project scheduling software* (both programs and apps) supports "what if" scenarios, tracks project efficiency, and analyzes schedules by using customizable Gantt charts, diagrams, and more. Other desirable features include the ability to run on multiple operating systems and the option to work in the cloud or via local installation.

Project scheduling software allows the project manager to enter the raw data for project tasks, project resources, and task durations, displaying the results in multiple common formats as needed. Most project scheduling software also includes the ability to create custom charts and reports.

The selection of software tools is often influenced by their price as much as their usability. For example, Microsoft Project is a popular choice, but it can be expensive; Microsoft Project Pro for Office 365 is offered as a per-user license, which can be cheaper. Other commercial options include Zoho Projects, FastTrack Schedule, Primavera P6, and Workfront.

Charts and Diagrams

Just by their nature, most projects have lots of information that needs to be disseminated to the project's sponsor, stakeholders, and team members. Unfortunately, raw data is hard for many people to understand, and it must be analyzed to reveal trends. Charts can put the data into a format more easily understood by everyone. Displaying project information graphically also makes it easy to determine the project's status, identify issues, and make decisions.

While many types of charts are used in projects, CompTIA has identified seven main chart types that Project+ candidates need to understand: process diagrams, histograms, fishbone diagrams, Pareto charts, run charts, scatter charts, and Gantt charts.

Both spreadsheet programs and all-in-one project management software can be used to create charts like the ones discussed in this chapter. Popular spreadsheet applications, such as Microsoft Excel, include charting capabilities and can convert data into project-specific displays. All-in-one solutions have these tools built in, but they typically allow you to export your data to and from common spreadsheet formats so that the data can be used across multiple tools.

The most common tool used to create charts like those discussed in this section is a spreadsheet application, such as Microsoft Excel. When using this method, the project manager will need to enter the data and use the spreadsheet functions to convert the data to a bar chart, Pareto chart, or any other chart.

NOTE For purposes of this discussion, the terms *chart* and *graph* are generally synonymous.

Key Topic

Process Diagram

A *process diagram* or *flowchart* is a sequential breakdown of the steps required to complete a business process, displayed in relation to each other. It includes the sequence of actions, inputs and outputs for each step, decision points, personnel involved, and time required. Process diagrams should be created for any procedure that is part of the project or is necessary for the project's completion, particularly business and manufacturing processes.

Process diagrams help project team members study a process for potential improvements or understand why the process is vital to the project. These diagrams can also be used to demonstrate to project team members and stakeholders how a process is conducted.

Figure 12-1 shows part of a process diagram for a procurement process.

The components in a process diagram generally use the following symbols (see Figure 12-2):

- Boxes detail individual steps.
- Arrows show direction flow from one step or decision to another.
- Diamonds mark decision points in the process. A question is written inside the diamond, with multiple arrows coming out of the diamond based on the potential answers to the question.
- Semi-circles show delays or waits in the process.
- Circles denote links to another page or another flowchart. The same symbol on the linked page or chart indicates that the flow continues at that point.
- Parallelograms designate input to or output from the process.

TIP Usage varies. Some organizations or artists may use these symbols in different ways, add other symbols, impart meaning with line width or color, and so on.

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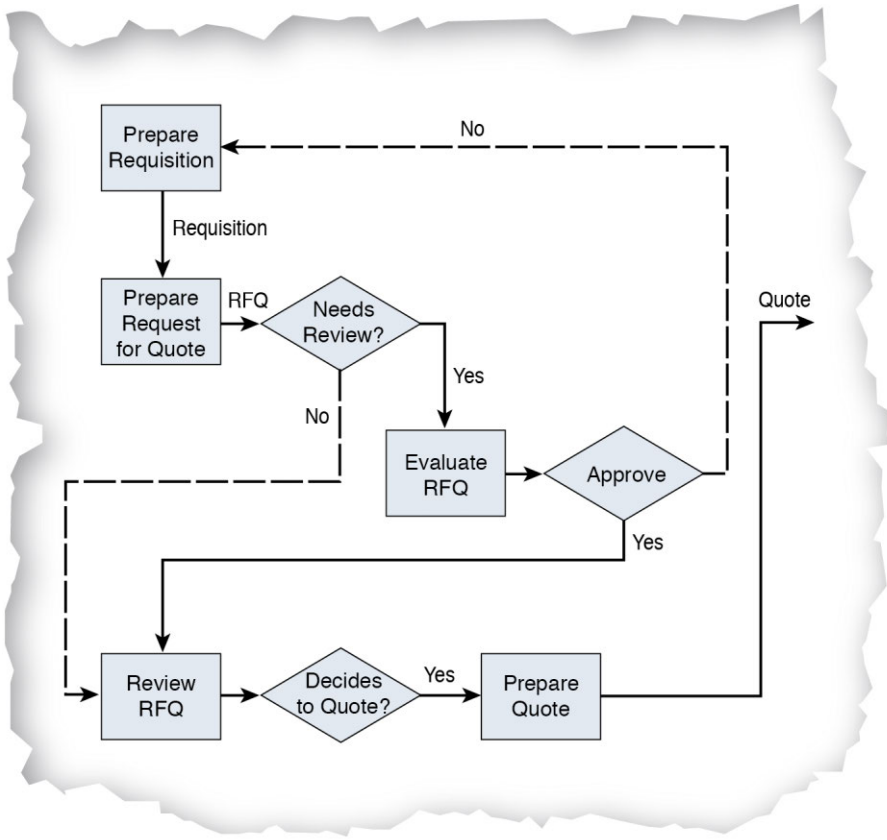


Figure 12-1 Example of a Procurement Process Diagram

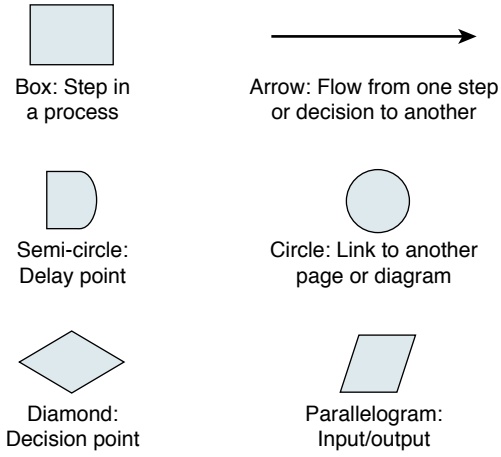

Box: Step in a process
Arrow: Flow from one step or decision to another
Semi-circle: Delay point
Circle: Link to another page or diagram
Diamond: Decision point
Parallelogram: Input/output

Figure 12-2 Common Symbols Used in Process Diagrams

A number of commercial software applications can make creating process diagrams easier. Microsoft Visio, Novagraph Chartist, RFFlow, WizFlow Flowcharter, 1888 Quick Flow Chart Creator, and other such applications vary in complexity, cost, and features. The project manager or the PMO should find the product that best suits the organization's needs. Some applications, such as Microsoft Visio, provide a bit more than just process diagrams, including network diagrams, data flow diagrams, and others that require specialized pieces.

Key Topic

Histogram

A *histogram* is a specialized type of bar graph. A standard bar graph depicts data by presenting different categories in separate bars, such as comparing the number of people who work outside the home against the number of people who commute to work by car. By contrast, the bars of a histogram represent continuous data for a specific range, such as the number of commuting drivers on the road during each hour of a 12-hour period. The data within the range is measured in terms of frequencies and intervals. The histogram's primary purpose is to graphically depict the approximate distribution of statistical data.

In project management, histograms are often used to show the frequency of causes of quality problems, in order to determine and understand preventive or corrective actions. However, histograms can also show other project data, such as the distribution of resources based on job title, or the usage of equipment. They can even be used to represent data gathered for a project, such as statistical population or income data that could be used as input to the project.

Figure 12-3 shows an example of a histogram that represents the number and types of phone calls received by a receptionist.

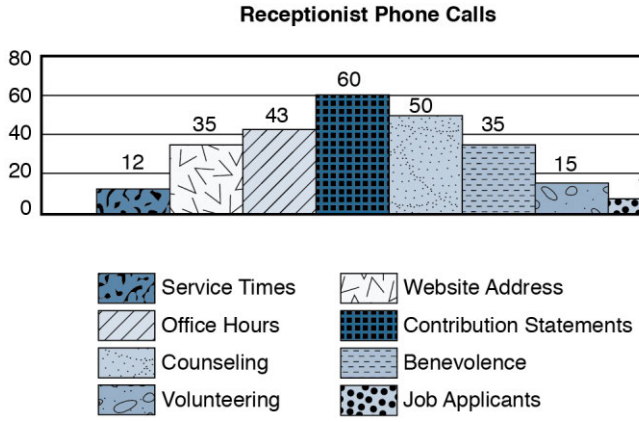


Figure 12-3 Example of a Histogram

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Key Topic

Fishbone Diagram

A *fishbone diagram*, also referred to as a *cause-and-effect diagram* or *Ishikawa diagram*, categorizes the potential causes of a problem to help the project team identify root causes. A project manager may use this tool for brainstorming when a team's thinking tends to fall into a rut.

The left side of the diagram lists the causes, broken into major categories. The identified causes will be placed in the appropriate cause categories as the diagram is built. The right side of the diagram lists the effect. The effect is written as the problem statement for which the project manager is trying to identify the causes. The partial fishbone diagram in Figure 12-4 shows reasons why product quality does not match quality standards.

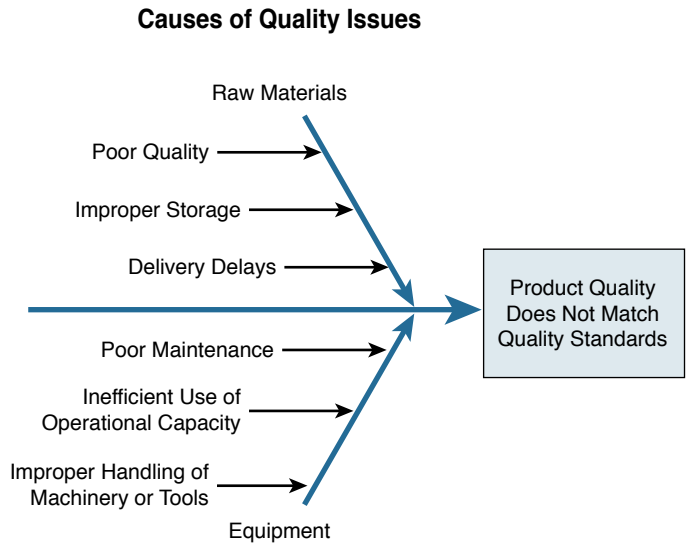


Figure 12-4 Example of a Fishbone Diagram

Fishbone diagrams are usually hand-drawn during project team meetings. Popular tools for creating fishbone diagrams include SmartDraw, Edraw Max, RCAXPress Fishbone Diagram Builder, XMind, and Nevron.

Key Topic

Pareto Chart

A *Pareto chart* helps project managers set priorities for quality control and is most often used in conjunction with fishbone diagrams. Project managers can find out the relative importance of or causes behind a project's problems as part of quality

management. The theory behind a Pareto chart is the "80/20 rule," which suggests that most of the problems in a project (80%) are caused by the same few factors (20%). The project manager can eliminate the largest number of issues by identifying which root cause to address first.

A Pareto chart combines a vertical bar chart with a line graph, showing importance or other values graphed from highest to lowest. The project manager uses a list of the project's problems as the base of the bar chart. The most common problem should be listed on the left side, and the least common problem on the right. Each parameter's importance is measured by several factors, such as frequency, time, or cost. Data points that represent the cumulative total percentage are plotted on the line graph.

Many Pareto charts include a cutoff cumulative percentage (such as 80%). Any bar that rises above that cutoff value shows the highest cumulative percentage of problems, which indicates the cause to prioritize. Data falling below the cutoff line indicates lower-priority root causes.

Figure 12-5 shows an example of a Pareto chart.

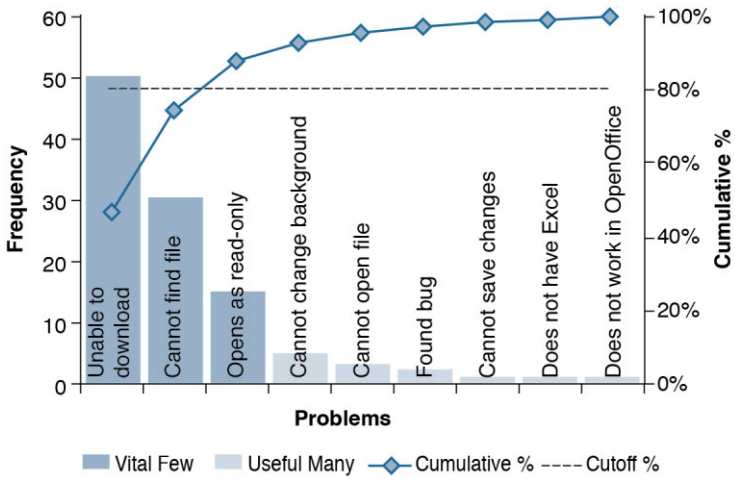


Figure 12-5 Example of a Pareto Chart

Key Topic

Run Chart

Like Pareto charts, a *run chart* is used in quality management. Run charts show trends, variations, or declines/improvements in a project over time, using a line graph (see Figure 12-6). Project managers can use run charts to analyze the following data trends:

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- Too many runs above or below the center line
- Too many points continuously increasing or decreasing
- Too many points on the same side of the center line
- Too many points alternating up or down

EXAMPLE: As a project manager, you need to document the number of coding errors detected weekly throughout an application development project. Team members work in teams to develop code, and then the teams review each other's code. They report the number of coding errors to you, and you document the total count in a run chart, with the goal of reducing the number of coding errors as the project progresses.

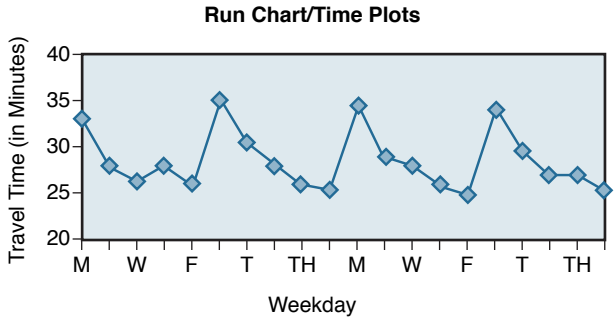


Figure 12-6 Example of a Run Chart

Key Topic

Scatter Chart

A *scatter chart*, also known as a *scatter diagram*, *scatter plot*, or *correlation chart*, is used to find the correlation between two variables, such as traffic speed and number of accidents. The first variable is independent, and the second variable is dependent on the first variable. The diagram shows how the dependent variable is affected by changes to the independent variable:

- No correlation between the variables (see Figure 12-7)
- Moderate correlation between the variables (see Figure 12-8)
- Strong correlation between the variables (see Figure 12-9)

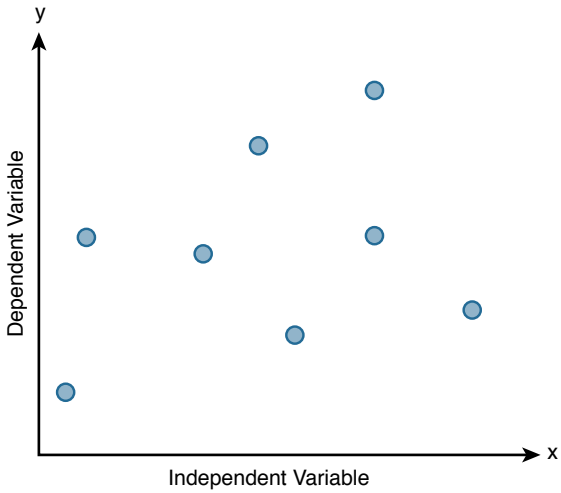


Figure 12-7 Scatter Chart with No Correlation Between the Variables

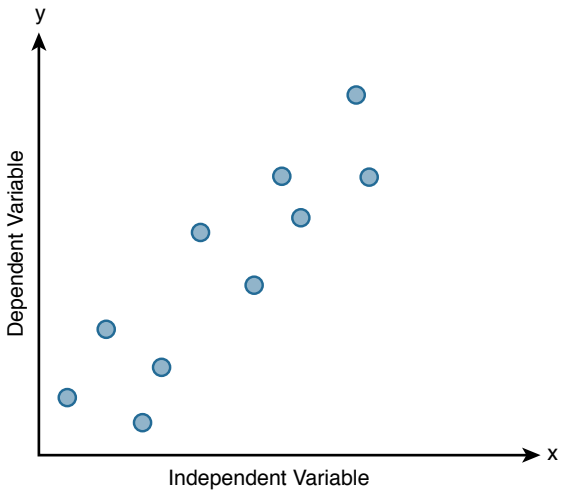


Figure 12-8 Scatter Chart with Moderate Correlation Between the Variables

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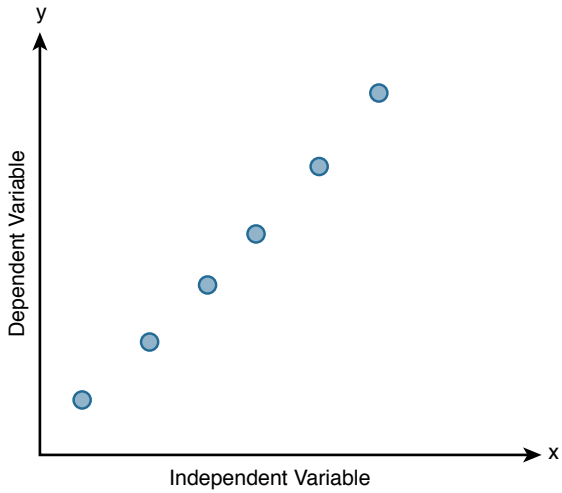


Figure 12-9 Scatter Chart with Strong Correlation Between the Variables

To interpret the scatter chart correctly, the project manager needs to understand *outliers*, which are data points that fall outside the pattern of the majority of the points. The *trend line* of a scatter chart is the line along which most of the points lie.

The scatter chart in Figure 12-10 shows the correlation between the number of visitors and the average daily temperature at a beach.

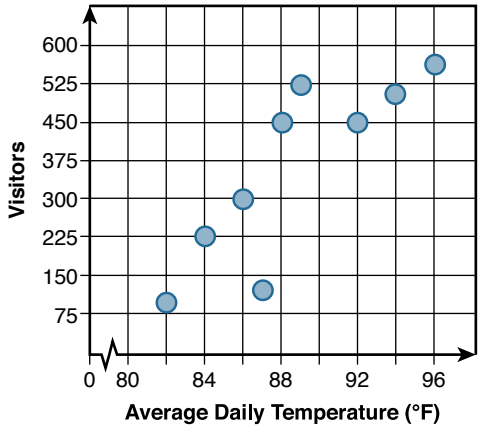


Figure 12-10 Scatter Chart Example

Key Topic

Gantt Chart

A *Gantt chart* displays a project's scheduled activities or tasks over time, often including the activity's dependencies and relationships. Gantt charts are one of the main tools used for project scheduling and can also depict the project schedule baseline. The left side of the chart lists the activities, and the top or bottom of the chart shows the time scale. The length and position of the bars within the grid depict each activity's start date, duration, and end date (see Figure 12-11). In a Gantt chart, the project manager, team members, and stakeholders can see the following schedule characteristics:

- Project activities
- Activity start and end dates
- Activity durations
- Activity overlap
- Project start and end dates

In some cases, Gantt charts may be modified to include information about the resources allocated to the activity, add milestones as zero-duration tasks, and mark critical activities.

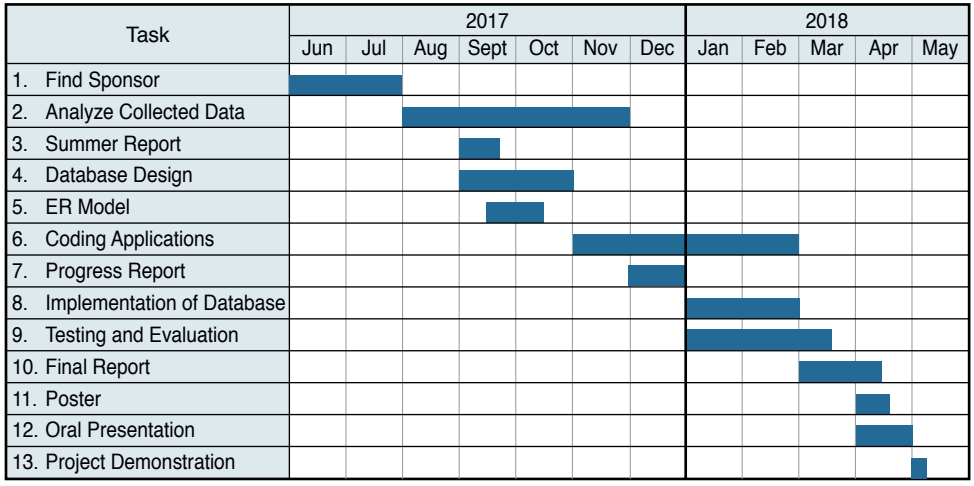


Figure 12-11 Example of a Gantt Chart

Project scheduling software and project management software provide built-in functionality for generating Gantt charts from the task, duration, and time data on a project. It is possible but time-consuming to create a functional Gantt chart with a spreadsheet application.

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Dashboards and Status Reports

Project charts and status reports are the easiest options for project managers to summarize and communicate key data about a project's status without overwhelming the audience. A type of graphical report called a *dashboard* displays important project status information, usually including key performance indicators, project metrics, current progress, and related issues. A written status report may or may not include sections from the dashboard; it is sent to the project sponsor and any stakeholders wanting this information.

Project management software or standalone dashboard applications allow the project manager to customize the information available on the dashboard. For example, the project manager may decide to create one dashboard with summary data for stakeholders and a separate dashboard for project team members with more detailed information. The following list describes some common dashboard formats.

- **Burndown dashboard:** Shows how many activities are completed and what is left to be done.
- **Cost overview dashboard:** Displays the current cost status of the project, usually including planned costs, remaining costs, actual costs, cumulative costs, baseline costs, and percentage of completion, to help determine whether the project will stay within budget.
- **Project overview dashboard:** Reports project activity completions, upcoming milestones, and activities that are past due.
- **Work overview dashboard:** Includes a work burndown for the project and the work statistics for all top-level tasks to help determine the percentage of completion and remaining work.

Popular project management applications with dashboard functionality include Microsoft Project, Asana, Basecamp, Mavenlink, and Smartsheet.

TIP A quick search online for "project overview dashboard images" will present plenty of ideas for constructing useful dashboards for your project.

Knowledge Management Tools

Project teams need to share information as the project progresses. Knowledge to be shared may include documented processes and procedures, available tools and technologies, databases, source code repositories, and so on. Knowledge management tools can provide a central location where all project team members can easily access shared data, regardless of their location or platform.

CompTIA expects Project+ certification candidates to be familiar with the features of common knowledge management tools: intranet and Internet sites, wiki pages, vendor knowledge bases, and collaboration tools.

Intranet and Internet Sites

An *intranet site* is accessible exclusively within an organization, and an *Internet site* is a website that is hosted publicly. Both can be used as project repositories. The project manager can add project information to an existing intranet or Internet site or set up a new site for the project. These sites usually include a task manager, project documents, a discussion board, a calendar, and general information such as team member biographies.

Websites offer several advantages for knowledge management:

- Data is accessible via web browser
- Easy to set up
- Low cost
- Improved productivity

The biggest disadvantage of using websites as knowledge management tools is the security implications, particularly for projects that are confidential or have a high monetary value. Even intranet sites can be susceptible to attacks. Prior to placing project information on an intranet or Internet site, the project sponsor and project manager should assess the project's data confidentiality needs and determine whether the value of sharing the project information within and/or outside the organization is worth the security risk. If organizations are concerned about the project's confidentiality being breached (such as proprietary information leaking to competitors), they might need to opt for a less-risky knowledge management tool.

Wiki Pages

A *wiki* is a type of website that is used to manage collaborative content. The wiki users determine the structure of the site and are able to edit the content on demand without going through a formal editing or upload process. While intranet and Internet sites require knowledge of web development technologies and languages such as HTML, wiki pages typically need little technology expertise. Wikis are particularly useful for projects requiring lots of documentation that will be accessed and edited by team members in multiple locations and time zones.

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For project management, using a wiki offers several advantages:

- Anyone can edit the content.
- Posting information on wiki pages is quick and easy.
- Shared data facilitates communication and discussion.
- Wiki pages can be linked to simplify accessing related data.
- All changes to wiki pages are tracked.
- Launching and maintaining a wiki is often less expensive than many other options.

But wikis also have disadvantages:

- Anyone can edit the content.
- Published sites may be open to spam and malware.
- Wiki structures can quickly become disorganized.

You may have noticed that the first advantage and disadvantage are the same in the two lists above. The ease of editing increases the likelihood of conflicting changes among multiple users, and published documents may not stay "finished" when users have the option to make further edits. Larger organizations may need to create style guides specifying language rules, product trademarks and service marks, and regulations dictating what can/cannot be published and/or changed in project documents.

Vendor Knowledge Bases

A *vendor knowledge base* is a database that contains authorized information about a particular vendor's products. Most operating system vendors, such as Cisco, Microsoft, and Apple, have extensive knowledge bases that are searchable by the public, though some content may be reserved for subscribers or product owners. Knowledge bases are particularly helpful if a project requires a particular vendor's products but the project team does not have extensive knowledge of the product.

Project managers should ensure that project team members know how to access and search vendor knowledge bases. Team members may also need to understand how to make requests in a vendor knowledge base for new or updated product information.

Collaboration Tools

Collaboration tools are used in projects to help the project team work together. A wide variety of tools is available to help team members collaborate, varying in function

from centralized document management to productivity to conferencing. These tools often allow for shared document management with version control. Collaboration tools focus on helping increase efficiency and output within the team, rather than communicating with individuals outside the team.

Popular project management collaboration tools include Asana, Projecteev, Podio, Redbooth (formerly Teambox), Trello, Flow, Conceptboard, Basecamp, Binfire, Projecturf, Wiggio, Zoho, and G Suite. Tools with less extensive capabilities focus mainly on file sharing: SharePoint, Dropbox, Microsoft OneDrive, WebEx, GoToMeeting, and Skype.

All project team members must know how to access and update project resources or communicate using the selected collaboration tool(s).

NOTE The Project+ exam focuses on the functionality that charts and knowledge management tools provide to a project. Do not expect to be tested on specific tools. The objective is about understanding the purposes of these tools and when you would select them.



Performance Measurement Tools

Projects need ways of quantifying success. *Performance measurement tools* such as key performance indicators, key performance parameters, and balanced score cards help project managers show project success in a measurable format. When such measurements are provided, even people who are unfamiliar with project terminology can understand how the project is performing.

CAUTION Be careful not to confuse *performance measurement tools* with *project quality tools*, which measure quality specifications in the project.

Key Performance Indicator (KPI)/Key Performance Parameter (KPP)

A *key performance indicator (KPI)* is a measure that evaluates the success of a project or deliverable in meeting objectives for performance. The U.S. Department of Defense (DoD) refers to these as *key performance parameters (KPPs)*. KPIs and KPPs are usually documented in the project dashboard.

Table 12-2 shows KPIs and KPPs that project managers typically provide in the dashboard.

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Table 12-2 Key Performance Indicators/Key Performance Parameters

KPI or KPP	Description
planned value (PV)	The planned cost for the amount of work that is currently completed.
actual cost (AC)	The actual money spent to date on a project.
earned value (EV)	The value a project has earned from the money spent to date.
cost variance (CV)	The budget deficit or surplus at any given point in time.
cost performance index (CPI)	The ratio of earned value to actual cost.
schedule performance index (SPI)	The ratio of earned value to planned value.
schedule variance (SV)	The difference between the earned value and the planned value.
return on investment (ROI)	The total dollar/time return the project sponsor will receive for the project. ROI is calculated using one of two formulas: ■ (change in operations cost) / (costs of project) ■ (change in revenue) / (costs of project)
cost of managing processes	An overview of time and resources spent on supervising and managing the project.
overdue project tasks (also called *crossed deadlines*)	The number of project activities that are overdue. A calculated percentage of project activities that go past their due date is compared to all completed project activities.
missed milestones	Indicates whether a project is running ahead of schedule, on time, or behind schedule.
percentage of tasks completed	Indicates how far along the tasks are toward completion.
resource utilization	Measures how the team members' time is used while working on the project. Specifically, this measurement shows how much time team members are spending on billable activities compared to the time spent on non-billable tasks, such as meetings.
percentage of projects completed on time	Helps demonstrate the overall project success for an organization.
percentage of canceled projects	Shows how sustainable an organization's projects are. Projects risk cancellation from internal factors such as lack of budget or sponsor support, or external factors such as regulatory or environmental issues. If too many projects are canceled, the organization should change its approach to project management or focus on different types of projects.

NOTE See Chapter 3, "Project Cost Control," for PV, AC, EV, CV, CPI, SPI, and SV and their formulas. Missed milestones are noted in the milestone list, which identifies all project milestones and indicates whether each milestone is mandatory. See Chapter 4, "Project Schedules," for details on milestones.

Other KPIs or KPPs may be added based on the organization's needs. Project managers should ensure that the project sponsor and stakeholders understand what each measurement means.

Balanced Score Card (BSC)

Understanding what management is trying to measure helps project managers gather and report the project information that affects those measurements. This understanding also helps explain to the project team why particular measurements are needed. In the organization's *balanced score card (BSC)*, management uses project management tools and principles to clarify the strategic targets for the organization as a whole, and not just its projects or its portfolio.

A BSC includes four sets of measures:

- **Financial:** The Financial section answers the question, "How can we show our shareholders that we succeed financially?" This section contains the financial targets for the organization, using *Specific*, *Measurable*, *Achievable*, *Realizable*, *Time-bound (SMART)* goals. This section typically includes statements like "Increase revenue by 15% during fiscal year 2018" or "Cut operating costs by 10% in Q4."
- **Customer:** The Customer section answers the question, "How can we align the customer's perception of our company with our vision?" This section ties the goals in the Financial section to how they will affect the organization's customers. For example, if a financial goal is to increase revenue, marketing and sales efforts may focus on obtaining a certain number of new customers or increasing the number of orders from current customers.
- **Internal Process:** The Internal Process section answers the question, "What business processes must excel, or what systems must be put into place, to achieve our Customer and Financial goals?" This section ties the organization's internal business processes and operations to the goals in the Financial and Customer sections. For example, if a Financial goal is to increase revenue, and a Customer goal is to obtain a certain number of new customers, the sales and marketing team may have an Internal Process goal of working together to develop new marketing materials to attract new customers.

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- **Learning and Growth:** The Learning and Growth section answers the question, "What knowledge, skills, and abilities will we need in order to support our Financial and Customer goals?" This section ties the organization's capabilities to the goals in the Internal Process, Customer, and Financial sections. For example, if a Financial goal is to increase revenue, a Customer goal is to obtain a certain number of new customers, and an Internal Process goal is to develop new marketing materials, the marketing team may need a new software application to help the team in developing new marketing initiatives.

Each section of the balanced score card should contain objectives, measures, targets, and initiatives. The project manager should study each section carefully to ensure that the project's goals align with the organization's goals, mapping project strategies back to the BSC in order to ensure project adoption and success.

SWOT Analysis

Strengths, *weaknesses*, *opportunities*, *and threats (SWOT) analysis* is used during the Planning phase of a project to identify project risks. The project manager uses this tool to identify areas within the project that may cause problems or present opportunities.

Strengths and weaknesses are internal factors, whereas opportunities and threats are external factors. With both of these groupings (internal and external), one factor of each is positive, and the other is negative:

- **Internal factors:** *Strengths analysis* addresses positive internal factors, while *weaknesses analysis* focuses on negative internal factors.
- **External factors:** *Opportunities analysis* looks at positive external factors, while *threats analysis* concentrates on negative external factors.

The project manager's SWOT analysis examines each of these aspects individually:

- **Strengths:** Analyze in-house skills and experience, budget sufficiency for all tasks, project benefits, and other similar projects to identify any strengths the organization or team provides for the project. Strengths include organizational track record, resource availability, skill levels, processes and systems, reputation, and so on.
- **Weaknesses:** Analyze the availability of contingency funds, outsourcing needs, schedule realism, and project drawbacks to identify any weaknesses in the project. Weaknesses might include issues such as gaps in knowledge and expertise, timescale and deadlines, budget and funding, processes and systems, and competing projects.

- **Opportunities:** Analyze competitor weaknesses, current industry trends, new technologies, and other areas of the business where opportunities should be seized to help the project. Opportunities could include technology development, infrastructure development, emerging and developing markets, new innovations, and market demand.
- **Threats:** To identify threats to the project, analyze whether team members are difficult to replace, required new technologies have been tested, changing trends will affect the project, or project results could be copied by competitors. Typical threats include environmental factors, competitor activities, economic factors, seasonal effects, and political factors.

Table 12-3 shows a SWOT analysis example for a new restaurant.

Table 12-3 SWOT Analysis Example

Strengths	Weaknesses
Location: Our first location downtown will draw in visitors and downtown shoppers.	**Lack of capital:** All startup funds will come from loans and investors.
Uniqueness: We stand out as a unique alternative to fast food, and we offer high-quality food in a distinctive atmosphere.	**Lack of reputation:** Though all our restaurants are successful, we need to establish a consistent brand.
Strong management: Our management team has successfully opened twelve concept restaurants in five years.	
Opportunities	**Threats**
Area growth: The city is growing by 8.5% annually.	**Competition:** One competitor sells similar foods and has loyal customers, as well as relationships with businesses that regularly buy from them.
Working families with children: This is a growing population, both in numbers and in their choice of convenient foods. Two-income families have less time to prepare meals.	**Being unprepared for opening numbers:** Poor service or product quality during opening week could discourage customers from returning.

SWOT analysis offers some advantages over complex analysis options, but disadvantages are also part of the bargain, as Table 12-4 shows.

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Table 12-4 SWOT Analysis Advantages and Disadvantages

Advantages	Disadvantages
Straightforward analysis.	Simplicity of creating a SWOT table may encourage list building rather than focusing on achieving objectives.
Low cost to perform.	A more expensive analysis might produce more useful results.
Produces new ideas quickly.	Does not organize ideas to fit established priorities.
Allows general response plans to be prepared.	Useful risk preparation requires a more detailed analysis.

RACI Matrix

The project manager creates the *responsible, accountable, consulted, and informed (RACI) matrix* during the Planning phase of a project to analyze the project stakeholder and team member roles and responsibilities in relation to project activities or tasks. For each task, the project must identify the following:

- **Responsible (R):** Who does the work to complete the activity?
- **Accountable (A):** Who is accountable for the activity?
- **Consulted (C):** Who provides information regarding the activity?
- **Informed (I):** Who needs to know the activity's progress?

To create the RACI matrix, most project managers start with the work breakdown structure (WBS) that is created during the Planning phase. A grid lists the project activities down the left-hand column. Then each project stakeholder or team member is listed in an individual column, with designations for each activity (R, A, C, and/or I) in the fields below the person's name or role (see Table 12-5). In most cases, only the project manager uses the RACI matrix. If other team members need this document, the project manager should explain that stakeholders should not be given access. Table 12-5 shows a RACI matrix template.

Table 12-5 RACI Matrix Template

Activity	Role 1	Role 2	Role 3	Role 4	Role 5
Activity 1.1	R	A	C, I		
Activity 1.2		R, A		C	I
Activity 2.1	I	I	R	A, C	
Activity 2.2	R		A	C, I	I
R = Responsible	A = Accountable		C = Consulted		I = Informed

The terms *responsible*, *accountable*, *consulted*, and *informed* need to be defined thoroughly so that no one misunderstands what is expected of those designations. Each activity should have only one person assigned the responsible (R) designation and one person assigned the accountable (A) designation. These may or may not be the same person. The C and I designations do not have assignment limitations. However, anyone with the I designation may be affected or may need to take action when that activity is complete.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 12-6 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 12-6 Key Topics for Chapter 12

Key Topic Element	Description	Page Number
Section	Overview of *project scheduling software*	247
Section; list; Figures 12-1 and 12-2	Discussion and example of *process diagram* (or *flowchart*)	248
Section; Figure 12-3	Discussion and example of *histogram*	250
Section; Figure 12-4	Discussion and example of *fishbone diagram*	251
Section; Figure 12-5	Discussion and example of *Pareto chart*	251
Section; list; Figure 12-6	Discussion and example of *run chart*	252
Section; list; Figures 12-7 through 12-10	Discussion and examples of *scatter chart*	253
Section; list; Figure 12-11	Discussion and example of *Gantt chart*	256
Section; list	Discussion and examples of *project dashboards*	257
Sections; lists	Overview of *knowledge management tools*	257
Section; lists; Tables 12-2 through 12-5	Overview of *performance measurement tools*	260

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Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

project scheduling software; process diagram; histogram; fishbone diagram; Pareto chart; run chart; scatter chart; outlier; trend line; Gantt chart; dashboard; status report; intranet site; Internet site; wiki; vendor knowledge base; collaboration tools; key performance indicator (KPI); key performance parameter (KPP); balanced score card (BSC); strengths, weaknesses, opportunities, and threats (SWOT) analysis; SWOT analysis; responsible, accountable, consulted, and informed (RACI) matrix; RACI matrix

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. A project team member has several questions about how sales occur, including how shipping decisions are made. Which document should the team member consult?
   - **a.** histogram
   - **b.** process diagram
   - **c.** Pareto chart
   - **d.** run chart

2. While managing a project, the project manager gives a histogram to a team member. Which of the following options *best* describes the purpose of this document?
   - **a.** identifying potential causes of problems
   - **b.** showing trends
   - **c.** graphically depicting the distribution of a process data set
   - **d.** displaying activities or tasks over time, including the activity's dependencies and relationships

3. A project team member is conducting some research on the project you are managing. When the research is complete, the project team member gives you a chart like the one shown in Figure 12-12. Which type of chart does this figure show?

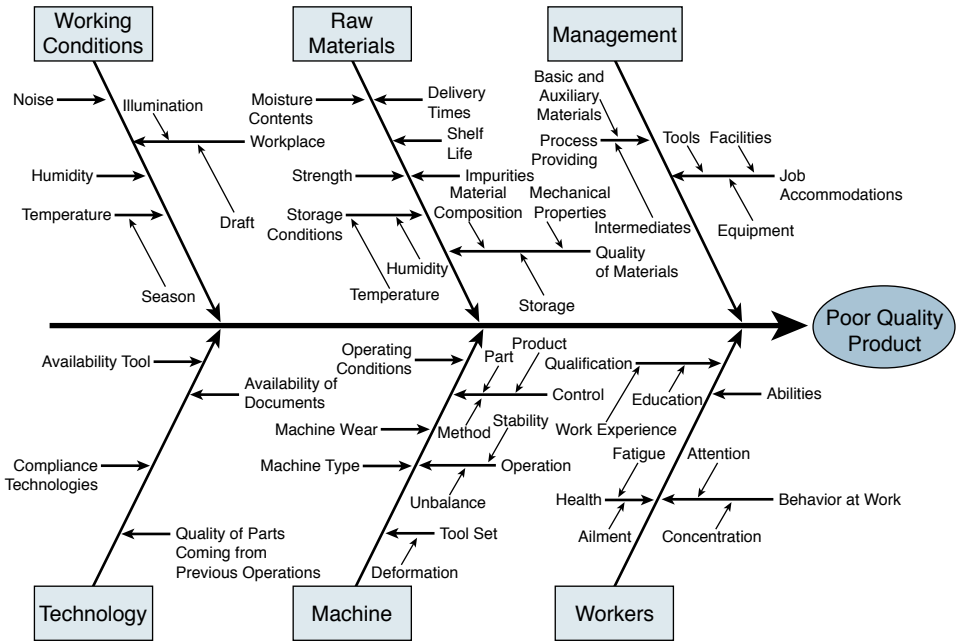


Figure 12-12 Acme Corporation's Widget Development

   a. run chart
   b. histogram
   c. process diagram
   d. fishbone diagram

4. You have decided to create a Pareto chart for the project you are managing. What is the purpose of this chart?

   a. showing the causes of problems, ranked by occurrence
   b. showing trends in quality
   c. showing correlation between two variables
   d. showing relationships between project activities

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5. A project team has created the chart shown in Figure 12-13. What type of chart is this team using?

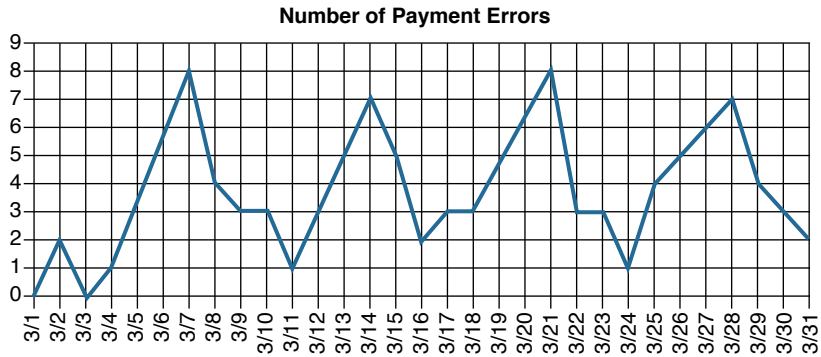


Figure 12-13 Chart Showing Payment Errors

   a. Gantt chart
   b. Pareto chart
   c. scatter chart
   d. run chart

6. You are the project manager for a large project. Your team needs a collaborative tool that allows the team to determine the structure of the tool and to edit it on demand. Which tool should you use?
   a. RACI matrix
   b. vendor knowledge bases
   c. wiki pages
   d. project scheduling software

7. You need to determine the total dollar return that the project sponsor will receive for a project. Which KPI should you use?
   a. CV
   b. ROI
   c. CPI
   d. PV

8. A project manager needs to map a project's objectives to ensure that the project aligns with the organization's goals. Which performance measurement tool is the best choice for this purpose?
   a. BSC
   b. KPI
   c. SWOT analysis
   d. RACI matrix

9. Which project tool is used during the Planning phase to identify project risks?
   a. RACI matrix
   b. SWOT analysis
   c. run chart
   d. scatter chart

10. During the Planning phase of a project, you are given the document shown in Figure 12-14. What type of document is this?

Ref	Task Description	Board	Steering Group	Project Sponsor	Project Manager	IT/Business Analyst 1	IT/Business Analyst 2	IT/Business Analyst 3	Departmental Manager	Departmental User 1	Departmental User 2	Departmental User 3
1	Requirements Specification											
1.1	User Interviews	I	I	C	A/R	R	C	C	C	C	C	C
1.2	Consolidate Requirements	I	I	C	A/R	R	C	C	C	C	C	C
1.3	First Draft of Requirements	I	I	I	A/R	R	C	C	I	I	I	I
1.4	Review Draft Requirements	I	I	A/R	I	I	I	I	A/R	C	C	C
1.5	Amend Draft Requirements	I	I	A	A/R	C	C	C	A/C	C	C	C
1.6	Sign Off Requirements	I	A	A	R	I	I	I	A	I	I	I

Figure 12-14 Project Document

   a. Gantt chart
   b. SWOT analysis
   c. RACI matrix
   d. Pareto chart

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This chapter covers the following topics:

- **Analyze project-centric documentation:** Project charter, project management plan, issues log, organizational chart, scope statement, communication plan, project schedule, status reports, dashboard information, action items, and meeting agendas and minutes.

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Project Documentation

Project managers are responsible for ensuring that all of the appropriate documentation needed for the project is created and managed throughout the life cycle of the project. Most project documentation is created during the Initiating and Planning phases of the project. Project documentation must be complete to help guide the project team and to ensure that the project results meet expectations.

Project team members refer to project documentation when questions arise about the project. Incomplete or incorrect documentation can cause project delays. Project managers should work with the project team and stakeholders to complete the project documentation and keep it up to date.

The project documentation should be familiar to you from discussions in earlier chapters. This chapter focuses on how analyzing that documentation can help the project manager and team members complete the project with the anticipated results.

NOTE The majority of the project documentation is introduced in Chapter 1, "Project Properties and Phases," and discussed throughout the book. This chapter focuses on the primary project documents listed in objective 4.2.

This chapter covers the following objective for the Project+ exam:

4.2 Given a scenario, analyze project centric documentation.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 13-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 13-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Project Charter	1
Project Management Plan	2
Issues Log	3
Organizational Chart	4
Scope Statement	5
Communication Plan	7
Project Schedule	8
Dashboard Information	6
Action Items	9
Meeting Agenda and Minutes	10

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which project document is used to create the project management plan?
   - **a.** action items
   - **b.** issues log
   - **c.** project schedule
   - **d.** project charter

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2. Which project document serves as the guide to the project team to ensure that the project's result meets the project sponsor's requirements?
   a. project schedule
   b. scope statement
   c. project management plan
   d. project charter

3. Which project document lists risks that occur that are *not* on the risk register?
   a. status report
   b. issues log
   c. action items
   d. project management plan

4. Which document should the project manager use to determine the reporting structure for project team members?
   a. organizational chart
   b. status report
   c. communication plan
   d. project schedule

5. Which project document includes project justifications, scope description, acceptance criteria, deliverables, exclusions, constraints, and assumptions?
   a. project charter
   b. scope statement
   c. dashboard information
   d. status report

6. Which project document is most likely to be accessed for project status information and KPIs?
   a. dashboard
   b. project schedule
   c. project management plan
   d. project charter

7. A stakeholder informs the project manager that he prefers to receive status reports as text messages. Where should this detail be located?
   a. project schedule
   b. organizational chart
   c. communication plan
   d. status report

8. Which project document should be analyzed to determine which team members are assigned to a project activity?
   a. dashboard
   b. organizational chart
   c. action items
   d. project schedule

9. Where should the project manager document activities that need to be completed that are *not* in the project schedule?
   a. project charter
   b. project schedule
   c. action items
   d. issues log

10. Which document should be prepared prior to a project meeting?
    a. meeting minutes
    b. meeting agenda
    c. dashboard information
    d. status report

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Foundation Topics

Project Charter

Key Topic

Created during the Initiating phase of a project, the *project charter* authorizes the project and allows the project manager to apply organizational resources to complete the project. The charter is formally issued by the project sponsor and includes the project's purpose, objectives, requirements, assumptions and constraints, high-level scope and risks, summary milestone schedule, summary budget, and stakeholder list.

The project charter is the starting point for the many documents that make up the project management plan (discussed next). Because the charter is the foundation of the project, the project manager and the project team should first analyze the charter whenever they create or update project documentation.

EXAMPLE: When to analyze the project charter: The project manager asks a project team member to help with project planning by creating the stakeholder register. The team member obtains a copy of the project charter and finds the stakeholder list located in that document. The team member may need to add stakeholders to the register, but the stakeholder list in the project charter provides a great start.

Project Management Plan

Key Topic

Created during the Planning phase of a project, the *project management plan* is the central document that defines all project work. It includes the following project documentation:

- All baselines, including:
  - **Scope baseline:** The project document used as the basis for comparing scope control during the Executing phase and the Monitoring and Controlling phase of a project. The scope baseline includes the project scope statement, work breakdown structure (WBS), and WBS dictionary.
  - **Schedule baseline:** The approved version of the project schedule.
  - **Cost baseline:** The approved project budget.
- All subsidiary plans, including:
  - **Scope management plan:** Describes how the scope is defined, developed, monitored, controlled, and verified.
  - **Requirements management plan:** Describes how project requirements will be analyzed, documented, and managed.

- **Schedule management plan:** Establishes the activities for developing, monitoring, and controlling the schedule.
- **Cost management plan:** Describes how costs will be planned, structured, and controlled.
- **Quality management plan:** Describes how the project's quality policies will be implemented.
- **Process improvement plan:** Details the steps for analyzing processes to identify activities that enhance their value.
- **Human resource management plan:** Describes how human resources will be structured and managed, including their roles, responsibilities, and reporting relationships.
- **Communication plan:** Describes how, when, and by whom information about the project will be distributed to the project team and stakeholders.
- **Risk management plan:** Describes all the known risks that may affect a project and the strategies that will be used to handle each risk.
- **Procurement management plan:** Also called *procurement plan*. Describes how goods and services for the project will be procured from outside sources.
- **Stakeholder management plan:** Defines the tools and techniques to engage stakeholders in project decisions and execution, based on each stakeholder's needs, interests, and impact on the project. Specifies how to manage each stakeholder's engagement level, relationships, and communication requirements.
- **Change management plan:** Defines how project change requests will be managed and implemented.
- **Configuration management plan:** Defines how the configuration of a product, result, service, or component will be documented, tracked, and defined as part of change management. The configuration management plan often works hand-in-hand with the change management plan.

NOTE Because Chapter 1 and this chapter cover different Project+ objectives, the coverage in the two chapters differs accordingly. Some of the documents discussed here are not covered in Chapter 1, and vice versa.

As the primary document used to manage the project, the project management plan serves as the guide to the project team to ensure that the project's result meets the project sponsor's requirements. Once the project baselines are in place, the project

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management plan can be changed only via the change control process. Project managers should consult the project management plan during the Executing phase and the Monitoring and Controlling phase of the project to ensure that the project is proceeding as planned.

NOTE The documents in the project management plan will be altered to reflect ongoing changes as the project progresses. For details on handling project changes, see Chapter 11, "Change Control."

EXAMPLE: When to analyze the project management plan: A project team member contacts the project manager about an issue with a project procurement. The team member feels that the procurement does not meet the specifications spelled out in the procurement contract. The project manager and project team member should consult the procurement management plan in the project management plan and then review the procurement contract to determine 1) whether the procurement meets the contract specifications and 2) the next step if the procurement does not meet the specifications.

Key Topic

Issues Log

The *issues log* is created during the Executing phase of the project and records all issues raised by stakeholders. The log is updated when new issues are identified or current issues are resolved. Issues logs from old projects can be analyzed to help with risk identification for a current project, because issues often arise as unanticipated risks that were not listed in the risk register. Issues may become risks, but not all risks start as issues. Like other types of changes, issues should be fully tracked via a numbering system. The issues log should also track the issue priority, issue type, target resolution date, and status.

Project managers should ensure that team members understand the difference between issues, risks, and change requests:

- **Issues:** Problems, gaps, inconsistencies, or conflicts that occur unexpectedly in the life cycle of a project and were not previously identified as risks. Issues affect the project already and need to be resolved.
- **Risks:** Uncertain events or conditions that would have an effect on at least one project objective if they occur. Most risks are identified during project planning.
- **Change requests:** Requests to modify the project in any way. Issues may or may not lead to risks or change requests.

The best way to differentiate between the three is to understand the following:

- An *issue* is something that occurs, must be addressed immediately for the project to proceed, and was not anticipated as part of risk management.
- A *risk* may or may not happen, but a plan is in place for it.
- A *change request* is a project modification that is requested during the project, may or may not be approved, and must be analyzed fully before approval and implementation.

EXAMPLE: When to use and analyze the issues log: An unexpected power outage results in a day of downtime for project work. If this event is not on the risk register, it is an issue and must be entered in the issues log. The project manager should work with the project team to adjust the project schedule and any other project documentation that will be affected by this issue.



Organizational Chart

A properly designed *organizational chart* is essential to project success. The organizational chart is drawn in pyramid form, showing where personnel fit into the project structure. Individuals near the top of the pyramid have more authority and responsibility than people located toward the bottom. The locations of the individuals' names and/or titles on the organizational chart show the working relationships, and the lines connecting the boxes designate formal supervision and lines of communication between the individuals.

Project managers need to make sure that the current organizational chart is available to project team members. In addition, a project's organizational chart may need to be created to help team members and stakeholders understand the project relationships. Project managers should also understand the organizational structure (functional, matrix, or projectized) to ensure that personnel are properly managed throughout the project life cycle.

NOTE Project team structures are discussed in Chapter 2, "Project Roles, Responsibilities, and Team Structures." Chapter 2 also provides examples of organizational charts.

EXAMPLE: When to analyze the organizational chart: A functional organization has a project that uses personnel from multiple departments. If the project schedule changes significantly, the project manager may need to negotiate with the functional managers to ensure that the required project team members will be available when needed, or when different personnel will be needed to complete new activities.

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Scope Statement

The *project scope statement* is a formal statement that includes project justifications, scope description, acceptance criteria, deliverables, exclusions, constraints, and assumptions. With the work breakdown structure (WBS) and the WBS dictionary, it forms the scope baseline that is created as part of the WBS process in the Planning phase. The scope statement must be formally approved by the project sponsor and can be changed only through formal change control procedures.

EXAMPLE: When to analyze the scope statement: A stakeholder requests a feature in a new application that is under development. The project manager needs to analyze the scope statement to see whether this feature is included as part of the project. If the feature is not part of the original scope, the stakeholder will need to submit a change request to add the feature.

Communication Plan

As mentioned earlier, the *communication plan* describes how, when, and by whom information about the project will be distributed to the project team and stakeholders. The communication plan provides overall guidance on all project communications, to ensure that all project team members and stakeholders receive timely and appropriate information.

NOTE The communication plan is discussed extensively in Chapter 9, "Communication Methods and Influences," and Chapter 10, "Communication Triggers and Target Audiences."

EXAMPLE: When to use or analyze the communication plan: A project has reached a milestone. The project manager should refer to the communication plan to determine who needs or wants to be informed of milestones and then use the preferred communication method(s) for those individuals.

Project Schedule

The *project schedule* shows project activities with their planned start/end dates, durations, milestones, and resources. The project schedule is usually maintained in project management software and updated as activities are started and finished. This tracking ensures that dependent activities are started on time.

NOTE Chapter 4, "Project Schedules," provides details on planning, executing, and revising the schedule for a project.

EXAMPLE: When to use and analyze the project schedule: The project manager is notified that activity Z is taking half the expected time to complete. Later in the project, activity Z will be performed twice. The project manager should adjust the task durations for both instances of activity Z, which will also cause changes in any activities that are dependent on activity Z. If either instance of activity Z is part of the critical path, the project manager will need to determine whether the critical path has changed. If changes are substantial, the project manager may need to communicate with the project team and stakeholders regarding the project schedule changes.

Key Topic

Status Reports

A project's *status reports* provide the latest information on project activities, issues, changes, and risks. Most projects hold regular status meetings. Status reports can be produced either for use in status meetings or as a result of status meetings, but usually a status report is just a summary. To get the full report of the status meetings, personnel should refer to the meeting minutes (discussed later in this chapter). Status reports are primarily created to ensure that the project sponsor, stakeholders, and team members who do not attend the status meeting still understand the project's current status. Project managers should ensure that the latest status report is incorporated into the project dashboard.

NOTE For more on project status reports and dashboards, see Chapter 12, "Project Management Tools."

EXAMPLE: When to use and analyze status reports: A project team member misses a status meeting, and he is responsible for completing an upcoming activity. However, he knows that an unplanned power outage in the last week affected the project schedule. To find out what decisions were made during the status meeting regarding this outage, he would need to read the status report. He might also need to consult the project schedule to see whether activities were adjusted for the outage.

Key Topic

Dashboard Information

Although project status reports are usually part of the *project dashboard*, the dashboard also may include other components such as key performance indicators,

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project metrics, project progress, and details of other project issues. This tool gives stakeholders and team members a quick look at the overall project.

NOTE For more on the use of project dashboards, see Chapter 12.

EXAMPLE: When to use and analyze the project dashboard: A stakeholder thinks that the project is over budget. The quickest way to check the budget situation is to locate the key performance indicators, such as the cost performance index (CPI) or cost variance (CV).

NOTE See Chapter 3, "Project Cost Control," for details on earned value management (EVM) calculations such as CPI and CV, with examples of how these values reflect various aspects of the project budget.

Key Topic

Action Items

Action items are project concerns that must be addressed. Meetings typically generate a list of action items, which should always be documented clearly to ensure that they are remembered and handled. Project managers must ensure that the project team understands the difference between issues and action items:

- **Issues:** Problems, gaps, inconsistencies, or conflicts that occur unexpectedly in the life cycle of a project and were not previously identified as risks. Issues are affecting the project already and need to be resolved. Issues usually require multiple resources and considerable time to resolve.
- **Action items:** Should require few resources—often only a single resource—and usually less than one week to resolve. These items should not cause delays in the project.

As action items arise, they should be added to an action item list and assigned to a project team member. Each action item should be assigned a priority and a completion date to ensure that it is completed in time for the project activity that it affects.

EXAMPLE: When to use and analyze action items: During a daily scrum meeting for a retail store remodel, the project team identifies several tools and supplies that will be needed for an upcoming project activity. The team needs to create an action item list detailing all these tools and supplies. The list could be divided by supplier or purchase location, and a project team member or two could be assigned to obtain these tools and supplies.

TIP In most organizations, basic supplies and small tools (such as a hammer or screwdriver) that cost under a certain amount may be purchased from a local store with a receipt provided. These purchases are considered action items rather than project procurements, which generally involve much higher spending limits, bid procedures, approved vendors, and contract terms.

Key Topic

Meeting Agenda and Minutes

A *meeting agenda* is a document that provides the topics of discussion for a meeting. The agenda should be established before every scheduled meeting. (The exception to this rule is daily scrum meetings.) When a scheduled meeting occurs, a team member should be assigned to keep minutes of the meeting. The *meeting minutes* are a record of all that is discussed and any decisions that are made during the meeting. The meeting minutes should be published formally for review by project stakeholders. Remember that the agenda is there to guide the meeting, and the minutes are created to record what happened during the meeting.

EXAMPLE: When to analyze meeting minutes: During the last status meeting, several new project risks were identified and resulted in lengthy discussions. The project sponsor was not at this meeting and asks the project manager to explain what happened. The project manager should refer to the meeting minutes to cover everything that occurred during the meeting.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 13-2 provides a reference of these key topics and the page number on which each begins.

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Key Topic

Table 13-2 Key Topics for Chapter 13

Key Topic Element	Description	Page Number
Section; example	Analyzing the *project charter*	277
Section; list; example	Analyzing the *project management plan* and its components	277
Section; lists; example	Analyzing *issues logs*	279
Section; example	Analyzing *organizational charts*	280
Section; example	Analyzing the *scope statement*	281
Section; example	Analyzing the *communication plan*	281
Section; example	Analyzing the *project schedule*	281
Section; example	Analyzing *status reports*	282
Section; example	Analyzing *dashboard information*	282
Section; list; example	Creating and analyzing *action items*	283
Section; example	Creating *meeting agendas*; recording and analyzing *meeting minutes*	284

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

project charter, project management plan, scope baseline, schedule baseline, cost baseline, scope management plan, requirements management plan, schedule management plan, cost management plan, quality management plan, process improvement plan, human resource management plan, communication plan, risk management plan, procurement management plan, stakeholder management plan, change management plan, configuration management plan, issues log, organizational chart, project scope statement, project schedule, status report, project dashboard, action items, issues, meeting agenda, meeting minutes

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. You are the project manager for a project to design and build sets for a Broadway musical. You need to start the planning process and create the project management plan. Which project document should you consult?
   a. scope statement
   b. project charter
   c. status report
   d. organizational chart

2. A new stakeholder has been added to a project that is already underway. The stakeholder has questions regarding the project scope, requirements, schedule, and budget. Which project document does the stakeholder need?
   a. scope statement
   b. dashboard information
   c. project management plan
   d. status report

3. During a project meeting, a stakeholder mentions that the venue for a planned project event may not be available for the day of the event. This was not a documented project risk. Where should this information be documented *first*?
   a. status report
   b. dashboard
   c. action items
   d. issues log

4. A project team member who was allocated to your project is unavailable. You have located a new resource, but that person works in a different department in your company, and you will have to negotiate with someone outside your project for that person's time. Which document can help you determine who to negotiate with for this resource?
   a. organizational chart
   b. communication plan
   c. project schedule
   d. project charter

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5. You are the project manager for a school remodeling project. The project sponsor contacts you, wanting to know whether the cabinetry in the classrooms will be replaced. Which document contains this information?
   a. organizational chart
   b. status report
   c. project charter
   d. scope statement

6. For which of the following questions would you need to analyze the communication plan?
   a. Which urgent actions need to occur within the next week?
   b. What topics were discussed at a meeting?
   c. Which stakeholders will receive a particular report?
   d. What topics will be discussed at an upcoming meeting?

7. Which of the following will not be found on the project schedule?
   a. resource assignments
   b. reasons for a delay
   c. activity dependencies
   d. activity lengths

8. A key stakeholder has been on vacation for a week. When she returns, she needs to get caught up on the project and its progress. What is the quickest way to do this?
   a. Examine the dashboard and status reports.
   b. Examine the project schedule.
   c. Examine the issues log and action items.
   d. Ask the project manager for a meeting.

9. In today's status meeting, a project team member stated that he needs a certain application and some specific research results to help with project completion. Where should this information be documented?
   a. issues log
   b. action items
   c. status report
   d. dashboard

10. A project team member is preparing for an upcoming status meeting, in which he has been asked to weigh in on certain issues to be discussed. Which document would provide guidance for him?

- **a.** issues log
- **b.** action items
- **c.** meeting agenda
- **d.** meeting minutes

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This chapter covers the following topics:

- **Understand common partner or vendor-centric documents and their purpose:** Documents include request for information (RFI), request for proposal (RFP), request for quote (RFQ), and mutually binding documents (agreement/contract, non-disclosure agreement, cease-and-desist letter, letter of intent, statement of work, memorandum of understanding, service-level agreement, purchase order, and warranty).

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Vendor Documentation

A procurement is any product, good, service, or result that needs to be acquired from a third party. The project's procurement management plan describes how any goods and services will be procured from outside sources, and the project manager should develop criteria for selecting procurement sources. Depending on the goods and services needed from third parties, the project manager may need to manage multiple suppliers and contract types.

Individual procurements are managed by vendor documentation, which includes the terms and conditions of the procurement. Because vendor documents are considered legally binding, such documents are usually reviewed and approved in a formal manner. Each document must contain all the specifications needed to ensure that the procurement meets the needs of the project. Each procurement is usually managed separately from the Planning through Closing phases of the project. Large projects may involve managing multiple procurement contracts. The project manager may need to understand an array of different types of vendor documentation, including request for information (RFI), request for proposal (RFP), request for quote (RFQ), and mutually binding documents.

This chapter covers the following objective for the Project+ exam:

4.3 Identify common partner or vendor-centric documents and their purpose.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 14-1

lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 14-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section(s)	Questions Covered in This Section
Request for Information (RFI)	1
Request for Quote (RFQ)	2
Request for Proposal (RFP)	3
Non-Disclosure Agreement (NDA)	4
Letter of Intent (LOI) and Memorandum of Understanding (MOU)	5

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which vendor documentation should be issued if the purchaser is unsure of the specifications of a procurement?
   - **a.** request for quote
   - **b.** request for information
   - **c.** request for proposal
   - **d.** statement of work

2. What is the purpose of a request for quote?
   - **a.** soliciting price quotations from prospective sellers of common products or services, such as computers or building materials
   - **b.** soliciting a potential seller to provide information related to the product, service, or seller's capability
   - **c.** soliciting proposals from prospective sellers of products or services
   - **d.** outlining the plans of an agreement between two or more parties

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3. Which vendor document is given to prospective sellers to obtain bids?
   a. RFI
   b. PO
   c. RFP
   d. SLA

4. Which document should be used to ensure that vendors and contractors do not share details of the project?
   a. MOU
   b. LOI
   c. SLA
   d. NDA

5. Which term is synonymous with LOI?
   a. PO
   b. MOU
   c. SLA
   d. RFI

Foundation Topics

At some point, most projects need to purchase services, materials, and/or equipment to conduct and complete the project. In project management standards, these purchases from contractors, providers, and so on (known collectively as *vendors*) follow a formal procurement process:

1. The project manager performs the appropriate make-or-buy analysis.
2. Once the decision is made to purchase from a vendor, the project manager documents details of the desired product or service and the source selection criteria.
3. Based on this information, a vendor document such as a request for information (RFI), request for proposal (RFP), or request for quote (RFQ) may be issued.
4. One bidder ultimately becomes the selected source and then evolves into the contracted supplier or seller. This part of the procurement process may involve mutually binding vendor documents such as a contract/agreement, non-disclosure agreement (NDA), cease-and-desist letter, letter of intent (LOI) or memorandum of understanding (MOU), statement of work (SOW), service-level agreement (SLA), purchase order (PO), and/or warranty.

In larger organizations, the accounting department typically provides the support needed to ensure that all procurements are completed according to documented business processes. Vendor or procurement documents can either be handled through the appropriate accounting personnel or by authorized project team members. A purchasing specialist or department may also be needed to help with project procurements. Procurement documents managed by the accounting department must be made available to the project manager and vice versa.

No matter who is responsible for the project's procurement process, the appropriate vendor documents must be created, maintained, and stored according to established business processes documented in the procurement management plan.



Request for Information (RFI)

A *request for information (RFI)* is a procurement document in which the buyer requests that a potential seller provide information related to the product/service or to the seller's capability to provide the product/service. In an RFI, the project manager does not provide project details, focusing instead on the vendor's capabilities, skills, and experience. This approach allows the buyer to pre-select service providers who have the appropriate capabilities for submitting a proposal. An RFI also helps

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vendors remove themselves from consideration if they cannot fulfill the stated needs of the project.

The RFI should state the following details: who is issuing the RFI, to which project the RFI applies, the RFI reference ID, the date of issuance, the WBS level of the project scope to which the RFI applies, the priority of the RFI, any specific queries or questions for which the issuer needs a response, and the deadline for responding to the RFI.

EXAMPLE: A small business needs to install a new network infrastructure as well as security devices to protect the network. The wiring and routers for this project have been ordered. To purchase a firewall, the project manager will need more information about firewalls and the services they provide. The project manager issues an RFI to obtain as much information as possible about available firewall products. After replies to the RFI are received, the project manager can consult subject matter experts (SMEs) to get their opinions on those responses.

The project manager should keep track of RFIs and be aware of when an excessive number of RFIs are being implemented. Too many RFIs could indicate incomplete contract or project documents or an incomplete study of the project's procurement needs. Excessive RFIs can result in project delays as well as additional costs.

Keep in mind these points regarding RFIs:

- RFIs are used when specifications cannot be finalized because of incomplete information or lack of understanding.
- RFIs help narrow the vendor pool.
- RFIs do not complete the contract.
- After receiving and analyzing all the vendors' responses to the RFI, the next step is to issue a request for proposal or a request for quote.



Request for Proposal (RFP)

A *request for proposal (RFP)* is a procurement document in which the buyer requests proposals from prospective sellers of products or services. An RFP should contain sufficient information that bidders know what is required and expected of their proposals. The RFP should include information on the requesting organization, relevant project information, project scope, bidder qualification requirements, timelines, and guidelines. With RFPs, suppliers are qualified after the RFPs are received.

EXAMPLE: The new network for a small business will require a high-speed Internet connection. The project manager for this project issues an RFP to prospective vendors to find out about available options.

When creating an RFP, project managers should keep the following tips in mind:

- Define the evaluation criteria up front to ensure that the selection team and the potential suppliers understand all the areas to be evaluated.
- Include a cross-functional section of RFP reviewers to obtain greater input into the price, contract, and financial issues associated with the purchase.
- Conduct reference calls and site visits to ensure that the prospective vendor is competent and capable of providing the product or service.
- Send all requests for communication to one person, to prevent multiple individuals from having to answer proposal questions.
- Promises made in the RFP should be incorporated into the contract to ensure that they remain part of the vendor's commitment.

The end result of an RFP is a procurement agreement or contract.

Request for Quote (RFQ)

Key Topic

A *request for quote (RFQ)* is a procurement document in which the buyer requests price quotations from prospective sellers of common products or services, such as computers or building materials. RFQs are used in place of RFPs when specifications are already known for the product or service. RFQs are issued only to vendors with which the buyer has previously worked; therefore, the suppliers are qualified prior to receiving the RFQ. Because so much information regarding the product or service is already known, the RFQ is mainly about pricing.

EXAMPLE: A small business is deploying a new retail sales application. With the application vendor's specifications for the checkout kiosk, server, and mobile devices, the project manager can issue an RFQ to prospective vendors to determine what these devices cost.

The RFQ process is considered transparent and easily understood. Project managers should ensure that the awarding criteria and weights document the following details:

- Product functionality or range of services
- Initial price
- Total cost of ownership (TCO)
- Risks with the product or service
- Risks with the vendor
- Ability to meet requirements

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Sealed bids ensure that no one can see the completed bids prior to the deadline. The bidding system opens after the submission deadline, and RFQs are reviewed by the selection team for awarding of the contract. If preset price targets are not met in the first round, a second round is possible, with limited participants given the price target.

The end result of an RFQ is a procurement agreement or contract.

Mutually Binding Documents

A *mutually binding document* is an agreement between two parties in which one party promises to do something for the other in return for payment. While the previously discussed vendor documentation is concerned with the procurement process prior to the awarding of the contract, project managers must also understand the mutually binding documents that are involved once the vendor is selected. Project managers should ensure that legal representation helps in drafting mutually binding agreements, in case these documents are needed in civil suits.

Project managers may need to understand multiple types of mutually binding documents, as discussed in the following sections.

Agreement/Contract

An *agreement* or *contract* is the document that spells out the conditions of the transaction between two parties. Such documents include fixed price contracts, cost-reimbursable contracts, and time-and-materials contracts. The type of contract is selected based on the needs of the project.

Project managers should understand the following contract types:

- **Firm fixed price (FFP):** The price for the procurement is set at the outset and cannot change unless the scope of work changes. The vendor absorbs any cost increase that occurs due to performance issues. Changes to the procurement specification will result in increased costs. This is the most popular type of contract.

  EXAMPLE: A project needs to purchase seven desktop computers that will be used for graphics applications. An FPP contract is used because the specifications are known and the computers are in stock or available within a relatively short period.

- **Fixed price incentive fee (FPIF) contract:** As with FFP, the price for the procurement is set at the outset. However, this contract includes a clause that ties financial incentives for the vendor to certain conditions—usually related

to cost, schedule, or technical performance, but with a price ceiling included. The final cost is determined after the work is complete.

EXAMPLE: A project needs to purchase a storage area network (SAN). The selected vendor has projected six weeks until the SAN is set up and available for use. If the project needs the SAN sooner, the project manager could use an FPIF contract in hopes that a financial incentive will speed up the vendor's process.

- **Fixed price with economic price adjustment (FP-EPA) contract:** The price for the procurement can be affected over time, because these procurement contracts can span a period of years. The price can fluctuate based on changing conditions such as inflation or commodity cost changes. Usually the economic adjustment clause is tied to a specific financial index.

  EXAMPLE: A long-term project involves building houses in a new neighborhood. Phase 1 will construct 50 homes in the first year of the project. Phase 2 will build 100 homes in the second year. Phase 3 will complete 200 homes in the third year. An FP-EPA contract would be the best choice for the lumber supplier for this project, because this type of contract allows the price to be adjusted based on current economic conditions.

- **Cost plus fixed fee (CPFF) contract:** The vendor receives payment for all allowed costs plus a fixed fee, which is a percentage of the estimated costs. The payment does not change unless the project scope changes.

  EXAMPLE: A high-risk medical project requires the services of a medical research firm. Because the project has many unknowns that will become clear only as the research progresses, the project manager and vendor may decide to use a CPFF contract to protect the research vendor.

- **Cost plus incentive fee (CPIF) contract:** The vendor receives payment for all allowed costs plus an incentive fee based on the objectives spelled out in the contract.

  EXAMPLE: In the high-risk medical project from the previous example, a CPIF contract could be used instead of the CPFF to encourage the vendor to cut costs or to complete the research early. The vendor would receive the incentive fee based on fulfilling the clauses in the contract.

- **Cost plus award fee (CPAF) contract:** The vendor receives payment for all allowed costs. The award fee is earned based on performance criteria spelled out in the contract.

  EXAMPLE: The high-risk medical project from the previous examples might decide to use a CPAF contract. This type of contract would pay an award fee

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based on a subjective evaluation of the vendor's performance, based on the purchaser's satisfaction.

- **Time and materials (T&M) contract:** These contracts are often used when a statement of work (discussed later in this chapter) is not possible. The full value of the contract and quantity of items needed may not be defined, so the contract is considered open-ended. Payment is given based on billable time and all allowed costs. These contracts often include not-to-exceed values, time limits, and unit labor or material rates.

  EXAMPLE: For a project to develop new housing over a multi-year period, a T&M contract could be used to hire a team of brick masons for the entire project.

Project managers should work with management and the project management office to determine the best type of contract to implement for each procurement. Many organizations have documented guidelines that can be used to help in this process.

Key Topic

Non-Disclosure Agreement (NDA)

A *non-disclosure agreement (NDA)* is a type of confidentiality agreement in which the selected vendor and any vendor personnel involved in the procurement agree not to disclose details about the project. NDAs are most often used when projects involve confidential information that will be shared with the vendor, but the project sponsor wants the information to remain private.

An NDA establishes the type of confidential information without actually revealing details, lists the parties that are covered by the agreement, and specifies the types of information that are *not* covered by the NDA.

EXAMPLE: A project developing a new mobile application has hired a third party to create the application's help files. The vendor and its technical writers should sign an NDA to prevent the leaking of any information about the application.

In some cases, NDAs may need to incorporate a *non-compete clause* or a separate *non-compete agreement* to prevent the vendor from pursuing a similar project with the buyer's direct competitors within a specified time period. The time period for enforcement of the NDA should be included in the contract, along with any penalties tied to the agreement.

EXAMPLE: A project is developing training material for security analysts. The project will hire a third party to provide a content development team. This team will need expensive education and preparation to ensure that they have the necessary skills to write the training material. The project manager includes a non-complete

clause in the NDA to ensure that the same team will not be used to develop material for a direct competitor.

Cease-and-Desist Letter

A *cease-and-desist letter* is sent to direct a person or entity to stop doing something immediately (cease) and never do it again (desist). This document usually applies to a particular activity, labor practice, or method of competition. Common examples are violating copyrights or patents. Cease-and-desist letters can include demands for compensation or a formal request for proper attribution to correct the violation. Cease-and-desist letters can be issued by themselves or in conjunction with civil lawsuits. A cease-and-desist letter from a legal representative usually carries more weight than one simply issued from the project sponsor.

EXAMPLE: While Company A is developing a new gaming system, it learns that a competitor has just launched a similar device based on technology patented by Company A's project sponsor. The project sponsor's legal representative should issue a cease-and-desist letter prior to filing legal action.

Letter of Intent (LOI) and Memorandum of Understanding (MOU)

A *letter of intent (LOI)* or *memorandum of understanding (MOU)* outlines the plans of an agreement between two or more parties, usually a precursor to a formal contract. This temporary measure is typically implemented to state that the parties are negotiating terms for the contract. The project manager should ensure that the LOI or MOU has a limited timeframe and that the formal contract is implemented as quickly as possible.

NOTE At the time of writing, CompTIA lists LOI and MOU as separate bullet points in the mutually binding documents section of objective 4.3. In the United States, these two terms are generally considered synonymous, so this discussion treats them as the same type of document.

An LOI or MOU is not legally binding but does carry a degree of seriousness and mutual respect, stronger than a "gentlemen's agreement." When either type of document is used, it implies that a binding contract is in the works.

EXAMPLE: During a project that will be launching a new education system, the project sponsor starts negotiations to purchase one of the project's vendors. The project sponsor issues a letter of intent to announce these negotiations.

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Statement of Work (SOW)

A procurement *statement of work (SOW)* gives a description of the procurement item so that prospective sellers know the specifications and can determine whether they can provide the procurement to meet the specifications. The SOW can include quantity needed, quality specifications, performance data, performance period, work location, and any other requirements.

EXAMPLE: For a project to produce training materials for a IT course, the contract will spell out the terms and conditions of the project, including payment information. The SOW includes details about the required end product, including any graphics, videos, and assessment questions that will be part of the product.

Each procurement requires a specific statement of work, but the SOW can group multiple related products or services that the vendor will provide as part of that procurement.



Service-Level Agreement (SLA)

A *service-level agreement (SLA)* is a contract between a service provider and its customer. The SLA sets specific metrics for different aspects of the service, including quality, availability, and responsibilities. For example, SLAs may exist between the project and its IT service, between organizations and their Internet service providers (ISPs), or between an organization and its cloud-computing provider. Some project services may be provided by a department within the same organization. In those cases, the SLA between the department and the project ensures that the promised services have a formal agreement. For example, an SLA between the IT department and the project ensures that the services needed by the project are documented.

The SLA should describe the type of service provided, the performance level, the steps for reporting issues, response and issue-resolution parameters, process and service-level reporting, and repercussions. Project managers should ensure that the parameters set forth in the SLA will satisfy the needs of the project.



Purchase Order (PO)

A *purchase order (PO)* is a document that is issued immediately after a contract is signed, clarifying the details of the purchase. The PO states the financial agreement, terms, method of delivery, delivery date, quantity needed, and so on, and is binding for the purchaser. Depending on organizational policies, project managers may need to issue POs only for purchases over a certain amount. Once the product or service is delivered, the vendor issues an invoice that references the PO. This practice allows proper accounting procedures to track the full transaction.

Key Topic

Warranty

A *warranty* provides an assurance of the level of quality for a procurement. In some cases, the warranty is included as part of the contract. However, some procurements, such as computers, routers, and other devices, may come with separate warranty statements. These warranties are valid for a certain period, usually a number of months or years. The warranty should be documented as part of any configuration management data that is captured for the procurement.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 14-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 14-2 Key Topics for Chapter 14

Key Topic Element	Description	Page Number
Section; list; example	Overview of *request for information (RFI)*	294
Section; list; example	Overview of *request for proposal (RFP)*	295
Section; list; example	Overview of *request for quote (RFQ)*	296
Section	Overview of *mutually binding documents*	297
Section; list; examples	Overview of *agreement* and *contract*; description of various contract or agreement types	297
Section; examples	Overview of *non-disclosure agreement (NDA)*	299
Section; example	Overview of *cease-and-desist letter*	300
Section; example	Overview of *letter of intent (LOI)* and *memorandum of understanding (MOU)*	300
Section; example	Overview of *statement of work (SOW)*	301
Section	Overview of *service-level agreement (SLA)*	301
Section	Overview of *purchase order (PO)*	301
Section	Overview of *warranty*	302

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Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

request for information (RFI), request for proposal (RFP), request for quote (RFQ), mutually binding document, contract, firm fixed price (FFP) contract, fixed price incentive fee (FPIF) contract, fixed price with economic price adjustment (FP-EPA) contract, cost plus fixed fee (CPFF) contract, cost plus incentive fee (CPIF) contract, cost plus award fee (CPAF) contract, time and materials (T&M) contract, non-disclosure agreement (NDA), non-compete clause, cease-and-desist letter, letter of intent (LOI), memorandum of understanding (MOU), statement of work (SOW), service-level agreement (SLA), purchase order (PO), warranty

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. You are the project manager for a project to design and build sets for a Broadway musical. You need to obtain a motorized mechanism that will allow certain parts of the stage to rotate 360 degrees automatically. You are unsure of the specifications for this procurement. Which procurement document should you use?
   a. RFQ
   b. RFI
   c. RFP
   d. SLA

2. You are the project manager for a project with multiple procurements, and you need to purchase the equipment to implement a lab network. This equipment includes servers, routers, and cabling. You already have details about the exact equipment models and specifications needed for the project. Which procurement document should you issue?
   a. RFI
   b. RFP
   c. RFQ
   d. PO

3. Which document is usually issued after an analysis of the RFI is complete?
   a. LOI
   b. SLA
   c. PO
   d. RFP

4. For your current project, a procurement is being purchased at a contract price that was negotiated with the vendor. If the procurement is delivered early, the vendor will receive a bonus. Which type of contract did you implement?
   a. FFP
   b. FPIF
   c. FP-EPA
   d. T&M

5. Divisions within your large corporation often work together on projects. Your project will obtain a procurement from another division of your company. The other division has agreed to provide the procurement for the cost of its materials plus labor. Which type of contract will be used for this procurement?
   a. CPAF
   b. CPIF
   c. CPFF
   d. T&M

6. While managing a project that includes a new patent granted to your company, you discover that another company is working on a project that will infringe upon your company's patent. Which type of document should you use to inform the other company of the issue?
   a. letter of intent
   b. memorandum of understanding
   c. cease-and-desist letter
   d. purchase order

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7. You have contracted a portion of a new mobile app to be developed by a third party. You need to ensure that personnel from that company do not share any details of this project with anyone. Which document should you use?
   a. cease-and-desist letter
   b. non-disclosure agreement
   c. letter of intent
   d. statement of work

8. After selecting a vendor based on the RFP, your company is in negotiations with the vendor regarding the purchase contract. However, as the project manager, you need to ensure that the project proceeds and that the vendor can start work. Which type of document should you use?
   a. LOI
   b. SLA
   c. PO
   d. SOW

9. The project you are managing needs wireless access to the Internet in one of your company's offices, which currently has no wireless access. Your company's IT department has agreed to provide this service until the project is complete. You need to ensure that a high degree of performance is maintained for project success. Which type of document should be drafted for this relationship?
   a. PO
   b. SLA
   c. SOW
   d. NDA

10. As the project manager, you are concerned that some equipment currently being purchased will not last for the duration of the project, which is three years. Which of the following should you check?
   a. request for proposal
   b. statement of work
   c. warranty
   d. service-level agreement



This chapter covers the following topics:

- **Testing your readiness for the Project+ exam:** How to take advantage of this book's special features in your final preparation for the exam.

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Final Preparation

Congratulations! You have completed 14 chapters of this book, covering the knowledge and skills required to pass the CompTIA Project+ (PK0-004) exam. Although these chapters supply the detailed information you will need to know for the exam, most people need more preparation than just reading the text. This chapter suggests additional ways to get ready for the exam.

TIP Before going through the final preparations in this chapter, and again before taking the Project+ exam, download and carefully review the latest exam objectives from CompTIA. The information in the objectives is subject to change without notice.

Take Advantage of the Tools in This Book

This book's special features are designed to help you self-test your understanding of the content on the Project+ exam. Perhaps you used some of these features as you worked your way through each individual chapter. Now you can combine them to see whether you are really ready for the exam, or you need more study in some areas.

Retake the "Do I Know This Already?" Quizzes

Use the multiple-choice "Do I Know This Already?" quiz in every chapter to assess whether you actually grasp the topics tested by the quizzes. Check your answers against those in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions." If your answer to a question was wrong, reread the relevant topic in the chapter.

Prepare for Vocabulary Differences on the Project+ Exam

In a worldwide industry like project management, standards and terminology are constantly changing. During the process of building this book, the author

and editors took special care to make the vocabulary of project management as consistent and clear as possible. Some terminology in the Project+ objectives and on the exam may not match what you have experienced in your project management work or in this book. Table 15-1 lists known differences in terminology as used by CompTIA in the Project+ objectives as this book went to press.

Table 15-1 Vocabulary Differences

Project+ Objective	CompTIA Phrasing	Standard Terminology
1.3	Initiation phase	Initiating phase
	Procurement plan	Procurement management plan
	Execution phase	Executing phase
	Monitor and control phase	Monitoring and Controlling phase
	Risks/issues log	Issues log
2.1	Budget constraint	Cost constraint

TIP Make sure that you are familiar with all of the acronyms and abbreviations listed in the latest version of the Project+ exam objectives.

Work Through the "Exam Preparation Tasks" Sections

If you have not yet worked through the "Exam Preparation Tasks" section in every chapter (or even if you have), use the features in that section to make sure that you are thoroughly conversant with the content that is likely to be on the Project+ exam:

- **Review All Key Topics:** The Key Topics table guides you to the most important information in the chapter. If your understanding of a topic is limited or vague, jump to the specified page number in the table, find the Key Topic icon in the margin, and start reviewing.
- **Define Key Terms:** The most important terminology in the chapter is listed in this section. Define each term, and then compare your definitions against those in the Glossary. If your definition was incorrect or incomplete, find that term in the chapter and refresh your memory.
- **Review Questions:** Use the 10 multiple-choice questions in each chapter to test your understanding of the chapter content. Check Appendix A for the answers, along with explanations that can help solidify the details you need to grasp.

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Complete the Memory Tables Appendixes

Appendix B, "Memory Tables," is available as a file on the companion website for this book. (To access the website, follow the instructions in the "Companion Website" section of the Introduction to this book.) Open the Appendix B file on the website, print the entire appendix, and complete the tables. Check your results against the completed tables in Appendix C, "Memory Tables Answer Key." If you are unsure of some of the answers or your answers were wrong, go to the relevant section in the chapter and refresh your memory. You will need to know the terms, formulas, and definitions in the memory tables to pass the Project+ exam.

Review the Examples

Even if you know all the facts in this book, you will not pass the Project+ exam unless you can analyze scenario-based questions and select the answer that best fits the conditions described. Before you take the practice tests or the live exam, page through this book one last time, scanning for **EXAMPLE** (all caps and boldfaced) in the text. These memorable project examples are designed to help you understand how the subject under discussion is related to handling real-life situations.

Practice with Pearson Test Prep

This book includes access to the Pearson Test Prep practice test software, a bank of unique exam-realistic questions available only with this book. Following the instructions in the "Using the Pearson Test Prep Practice Test Software" section of the Introduction, use the practice tests developed with this book to verify your readiness for the Project+ exam.

Ready, Set, Test!

This book was developed with the intention not just to present information you will need to pass the Project+ certification exam, but to help you understand the relevant details and learn how to apply them in project management. The author and editors of this book wish you every success!



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Answers to the "Do I Know This Already?" Quizzes and Review Questions

Chapter 1

"Do I Know This Already?" Quiz

1. B. A project is temporary, not permanent. A project has a defined start and finish, is unique, and has a stated reason or purpose.
2. A. An organization's portfolio consists of all of the projects, programs, and operations that it manages in order to reach its strategic objectives.
3. C. The project charter is created during the Initiating phase of the project.
4. D. The work breakdown structure (WBS) is created during the Planning phase of a project.
5. A. Project deliverables are created during the Executing phase of a project.
6. C. The project manager directs quality assurance during the Monitoring and Controlling phase of a project.
7. D. Change control is an activity in the Monitoring and Controlling phase of a project.
8. B. Human resource management is primarily concerned with organizing and managing the project team to complete the project.
9. C. Threats to the project are identified as part of risk management.
10. B. The budget is created as part of cost management.

Review Questions

1. C. Installing the latest operating system and application updates is *not* a project. It is part of day-to-day operations and will be repeated each time updates are ready to be deployed.

2. D. It is *not* true that all of the projects listed are part of the project portfolio. The antivirus and anti-malware updates are *not* a project. They are normal day-to-day operations and will be repeated each time updates are ready to be deployed.
3. B. You complete the project charter and business case for a new project in the Initiating phase.
4. A. The budget and schedule are created during the Planning phase.
5. B. The Monitoring and Controlling phase includes identifying issues and risks after project deliverables are created.
6. C. You are completing the Closing phase when you document the lessons learned, release the project resources, and obtain project sign-off from the project sponsor.
7. A. Quantitative and qualitative risk analysis is performed during the Planning phase.
8. D. Acquiring the project team and performing quality assurance occur during the Executing phase.
9. A. Project time management includes sequencing activities.
10. B. You should ensure that the project team receives the appropriate training during the Executing phase.

Chapter 2

"Do I Know This Already?" Quiz

1. A. The sponsor gives the final approval for a project.
2. B. The project manager does *not* create the project deliverables; the project team creates the deliverables. The project manager manages the team, creates the budget, and creates the schedule.
3. D. The project coordinator supports the project manager and coordinates cross-functional tasks.
4. C. The project stakeholders provide project requirements.
5. D. The scheduler is primarily concerned with managing project time.
6. C. The project management office (PMO) is not concerned with estimating costs. The PMO sets project management standards, provides templates, and provides tools.

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7. B. Hybrid is *not* a project team structure. Project team structures include matrix, functional, and projectized.
8. C. In functional team structures, project managers hold little to no authority.
9. A. In a projectized team structure, resources report to the project manager.
10. C. Resources are most likely to be assigned from their functional area to the project in a functional team structure.

Review Questions

1. C. You should obtain approval of the project charter and preliminary budget from the project sponsor.
2. D. You will fill the project manager role.
3. B. A project coordinator will support you and provide cross-functional organization.
4. A. The project team is not responsible for creating the project schedule. That is the job of the project manager (or project scheduler, if applicable).
5. B. You are identifying the project stakeholders, which includes all individuals or groups who have a vested interest in the project.
6. C. The project scheduler is solely responsible for ensuring that project time is managed and reported.
7. A. Your company has a functional team structure, with all team members reporting to their department managers.
8. D. The weak matrix project team structure gives the project manager only slightly more authority than the functional team structure does.
9. A. Project managers have the most authority in a projectized project team structure.
10. B. The project coordinator or project manager—*not* the scheduler—checks project quality.

Chapter 3

"Do I Know This Already?" Quiz

1. A. Cost control involves monitoring the project's costs and managing changes to the cost baseline.
2. B. Total project cost includes all costs specific to the project incurred until the Closing phase is complete.

3. C. The formula for calculating PV is (planned % complete) × budget.
4. D. The AC + ETC formula calculates EAC using ETC.
5. D. A TCPI greater than one indicates that the project is under budget.

Review Questions

1. D. Planned value (PV) = (planned % complete) × budget. Therefore, PV = 40% × $1,000,000 = $400,000.
2. C. Actual cost (AC) is the actual money spent to date on a project. Therefore, AC = $600,000.
3. B. Earned value (EV) = (% of completed work) × budget. Therefore, EV = 40% × $1,000,000 = $400,000.
4. B. Schedule variance (SV) = EV – PV. EV = 40% × $1,000,000 = $400,000. PV = 60% × $1,000,000 = $600,000. So SV = $400,000 – $600,000 = –$200,000.
5. D. Cost variance (CV) = EV – AC. EV = 40% × $1,000,000 = $400,000. AC = $600,000. So CV = $400,000 – $600,000 = –$200,000.
6. D. Schedule performance index (SPI) = EV / PV. EV = 40% × $1,000,000 = $400,000, and PV = 60% × $1,000,000 = $600,000. So SPI = $400,000 / $600,000 = .67.
7. C. Cost performance index (CPI) = EV / AC. EV = 40% × $1,000,000 = $400,000. AC = $600,000. So CPI = $400,000 / $600,000 = .67.
8. D. Burn rate = 1 / CPI.
9. B. The project is over budget for the amount of work completed. A positive CV indicates that the project is under budget for the amount of work completed, and a negative CV indicates that the project is over budget for the amount of work completed. A value of zero indicates that the cost for the work completed is on budget.
10. A. The project is consuming the budget slower than planned. A burn rate greater than one indicates that the project is consuming the budget faster than planned and will exhaust the budget before all the work is completed. A burn rate of less than one indicates that the project is consuming the budget slower than planned and will be completed within the budget. A burn rate of one indicates that the project is consuming the budget as planned and will be completed on budget.

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Chapter 4

"Do I Know This Already?" Quiz

1. A. A dependency occurs if task B relies on the completion of task A and should start after task A is complete.
2. B. The critical path is the sequence of tasks comprising the project path that takes the longest amount of time.
3. C. The method for determining the late start (LS) and late finish (LF) of project tasks is to start with the last task(s) and perform a backward pass through all the tasks.
4. B. The work breakdown structure (WBS) is used to determine project tasks.
5. D. Float for a task is the difference between the late start (LS) and early start (ES) values for the task.
6. D. Quality gates provide acceptance criteria to ensure that the project tasks are completing deliverables within the quality control guidelines established during project planning.
7. C. The work breakdown structure (WBS) subdivides the project work into manageable components.
8. B. A predecessor task must be completed prior to starting the next task.
9. A. Milestones are significant events in a project.
10. C. The critical path is used to calculate each task's early start (ES), early finish (EF), late start (LS), and late finish (LF).

Review Questions

1. B. The possible paths for this project are A–E–H–I–L–M, A–E–H–J–L–M, B–H–I–L–M, B–H–J–L–M, C–F–H–I–L–M, C–F–H–J–L–M, and D–G–K–L–M. The critical path is A–E–H–J–L–M, which has a value of 27. A–E–H–I–L–M has a value of 26. B–H–I–L–M has a value of 16. B–H–J–L–M has a value of 15. C–F–H–I–L–M has a value of 17. C–F–H–J–L–M has a value of 18. D–G–K–L–M has a value of 14.
2. D. Task E's predecessor is task A, which has an early finish (EF) of 10. Task E's early start (ES) is the same day as task A's EF (10). So the ES of task E is 10.
3. A. Task E's predecessor is task A, which has an EF of 10. Task E's early start (ES) is the same day as the EF of task A (10). To determine task E's EF, add task E's duration (3) to its ES value (10). Task E's EF is 13.

4. B. An event on the project calendar that has no duration is most likely a milestone.
5. C. Use the late start (LS) and early start (ES) values of a task to determine float or slack.
6. D. The resource breakdown structure lists allocated resources hierarchically by category and type.
7. A. Governance gates are included in project schedules to ensure that required approvals are obtained.
8. B. A forward pass determines ES and EF for all project tasks.
9. C. Resource leveling might increase the critical path.
10. D. The schedule baseline will help you determine if tasks are slipping and will affect the final completion.

Chapter 5

"Do I Know This Already?" Quiz

1. C. Storming occurs when the team starts making decisions about the project.
2. B. Preassigned resources are personnel who are assigned to the project from the start based on their positions in the organization or their knowledge and skill sets.
3. A. Smoothing involves emphasizing areas of agreement rather than differences.
4. D. Forcing should be used as a last resort to resolve a long-lasting conflict.
5. A. Shared resources are used jointly between multiple projects.
6. B. A resource shortage is most likely to cause delays in the project schedule.
7. C. To ensure that low-quality resources are not used in a project, the project manager should consult with experts to ensure that the resource specifications are listed in the project documentation.
8. D. Benched resources are available for project usage but are not being utilized.
9. B. Resource contention is an issue when resources are used by multiple projects that have overlapping schedules.
10. D. Depending on the organizational structure, the project manager, project management office (PMO), or functional manager could decide which project gets priority.

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Review Questions

1. C. The trust-building stages of a project team are forming, storming, norming, performing, and adjourning.
2. D. At the storming stage, the team starts making decisions about the project. Forming is when the team meets and learns about how they will work together in the project. The team starts working together in the norming stage and works as a unit in the performing stage.
3. B. The consultants are acquired resources.
4. A, B, C, D. All of the listed options are disadvantages of using virtual teams.
5. B. Because one side of the issue is clearly wrong and continued discussion of the issue could be detrimental to the project, you should use smoothing.
6. C. You most likely used compromising, because you reached a solution that did not satisfy either party.
7. A. Both projects will need to use the servers at the same time, making them shared resources.
8. D. When many resources are left over, it is usually the result of a resource overallocation.
9. A. If the UPS cannot handle the necessary load, it is a low-quality resource.
10. B. You should give priority to project A because it has only three days of float.

Chapter 6

"Do I Know This Already?" Quiz

1. D. Agile projects are adaptive, allowing the project to meet changing conditions.
2. C. The iterative quality of Agile projects allows each incomplete area to be refined until the result is satisfactory.
3. B. User stories are used in Agile planning to help with requirements gathering.
4. A. The purpose of burndown charts in Agile projects is to track the completion of tasks for the current sprint.
5. B. Continuous feedback is required for an Agile project to succeed.
6. D. The team does *not* estimate the tasks during sprint planning. In sprint planning, the team uses burndown charts to gather requirements, decides on the sprint duration, and selects the target backlog that will be addressed during the sprint.

7. D. "What went wrong during this sprint?" is *not* answered in the daily scrum meetings. All of the other questions are answered in the daily meetings.
8. C. The scrum master should document and prioritize actions and lessons learned prior to starting the next sprint.
9. B. A scrum retrospective should be held after every sprint.
10. B. Agile teams are self-organized and self-directed.

Review Questions

1. B. Agile allows the project direction to be modified easily based on the organization's needs.
2. A. With each iteration of an Agile project, the product is improved.
3. C. When you are creating user stories, you are gathering the requirements for an Agile project.
4. D. Team members decide the assignment of tasks for a project that uses a burndown chart.
5. C. The blue line on a burndown chart indicates the remaining effort on a daily basis.
6. D. If the blue line is below the red line on a burndown chart, the project is proceeding at an accelerated rate and may finish earlier than expected.
7. A. If the blue line of a burndown chart crosses the red line multiple times, it indicates that the project team is performing inconsistently.
8. A, B, C. The team members, product owner, and scrum master must attend the sprint planning meeting.
9. C. During a daily scrum meeting, all team members should give updates regarding sprint tasks.
10. D. You should hold a scrum retrospective prior to starting the next sprint.

Chapter 7

"Do I Know This Already?" Quiz

1. D. Cost is most strongly affected if a project team member will have a higher rate of pay than originally estimated. Time, scope, and cost are considered the triple constraints for a project.

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2. A. A new requirement for a web application would mainly affect the project's scope. Acquiring a new team member would mainly affect the project schedule (time) and budget (cost). Labs and materials being unavailable when needed would mainly affect the schedule (time).
3. B. If a project team member can complete tasks at a faster rate than estimated, the most strongly affected constraint is time (schedule). Project cost may also be affected but would not be the most strongly affected. Quality and scope are not likely to be affected by tasks being completed faster than expected.
4. D. This is an example of a change request because the new feature was formally approved by the project sponsor. The change request process also includes an assessment of the effect of the change on the time and cost constraints. Any additional funding or schedule adjustments will also be approved as part of the change control process. This example does not describe scope creep, which is when scope changes occur without adjusting the other project constraints.
5. A. Because the project sponsor requested 10 additional server racks, this is an example of scope creep. Scope creep occurs when the scope changes.
6. A. Constraints are listed at a high level during the Initiating phase of a project, and further refined in the Planning phase. However, events in the Executing phase can influence the constraints, causing a need for changes in one or more constraints, particularly if one of the triple constraints is affected. See Chapter 1, "Project Properties and Phases," to learn about the phases of a project.
7. C. All constraint changes need the sponsor's okay. Following the designated change control process, the project manager must obtain approval of the necessary changes from the project sponsor. See Chapter 11, "Change Control," to learn about the change control procedures.
8. A. The triple constraint is scope, time, and cost.
9. B. The provision for on-site training is a requirement, not a constraint. It must be delivered three weeks before project closure, but no constraint affects the closure date. The other options describe a time constraint, a cost constraint, and a scope constraint.
10. B. This is an interaction between the environment and scheduling constraints. Answer A is a change request, C describes a management influence, and D is an example of scope creep.

Review Questions

1. A and B. You could request additional funds from the project sponsor and/or find ways to cut costs in other areas of the project. With either solution, you should adjust the budget to reflect the correct cost for the supplies.

2. C. You should obtain additional funds to cover the new feature development. Afterward you would need to adjust the schedule to account for the new feature development.
3. D. Cost and time should be adjusted as a result of hiring a new project team member.
4. A. Cost, time, and scope should be adjusted as a result of adding a new deliverable.
5. D. Cost and time should be adjusted as a result of the higher-quality vinyl requirement.
6. B. Time should be adjusted as a result of the lab environment not being available when you need it.
7. C. Cost should be adjusted as a result of needing to rent a backhoe for the project.
8. A. This is an example of a change request.
9. B. This is an example of scope creep.
10. C. This is an example of constraint reprioritization.

Chapter 8

"Do I Know This Already?" Quiz

1. C. Risk planning identifies, quantifies, and reviews risks.
2. B. The risk identification process creates the first version of the risk register.
3. D. Quantitative risk analysis involves assigning numerical values to the identified risks.
4. A. The main benefit of risk review is identifying new risks.
5. C. *Threats* is another term for negative risks.
6. D. The risk register lists all known risks and gives details about each risk.
7. B. Risk exploitation is a strategy for positive risks.
8. A. Risk acceptance is a strategy for both positive and negative risks.
9. C. Purchasing insurance is the most common form of risk transference.
10. A. Risk enhancement uses the key drivers to ensure that the risk occurs.

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Review Questions

1. B. The group is working on risk identification.
2. C. Assigning numerical values to all project risks is quantitative risk analysis.
3. D. You should adjust the risk's probability in the risk register.
4. A. You should perform risk review to ensure that all project risks are identified. (The formal risk identification process occurred before you took on the project.)
5. D. The risk register lists all information about the identified project risks.
6. B. Risk acceptance should be selected because the cost of the mitigation is higher than the cost of the risk itself.
7. C. The risk is mitigated by implementing a redundant network backbone.
8. A. Purchasing builders' risk insurance transfers risk from the builder to the insurance company.
9. B. The four risk strategies for handling positive risks are accept, exploit, enhance, and share.
10. C. Risk sharing splits the positive risk between the two companies.

Chapter 9

"Do I Know This Already?" Quiz

1. D. The most effective method is face-to-face communication. The other methods listed do not allow the participants to read each other's body language.
2. C. A kickoff meeting is held to ensure that team members and stakeholders understand the project goals and their part in the project.
3. B. Language barriers would most likely lead to the need for a translator.
4. A. Rapport building is most likely to help ensure good relationships between team members.
5. B. Geographical factors and cultural differences are the two most likely communication issues that the team will need to address.

Review Questions

1. D. You should hold a kickoff meeting to introduce all the team members and make sure that they understand their project duties.

2. C. You should hold a virtual meeting because the team members are in different geographical regions.
3. B. In this situation, social media would be the best communication method. It ensures that customers and other interested parties will see the press releases on the project progress.
4. A. You should hold separate face-to-face meetings with each of the team members. This will give each team member a chance to speak freely about his or her feelings and experiences.
5. B. Your primary concern for communications on this project is possible language barriers. Cultural differences and geographical factors will be secondary to the language issue.
6. A. You should consult with the project sponsor to verify that the stakeholder needs the information. This approach ensures that the original evaluation denying the stakeholder access to this information is valid.
7. C. Intraorganizational differences occur when team communication is influenced by conditions within the organization.
8. D. The team member's unreliable Internet access is a technological factor for project communication.
9. D. You should provide just the facts orally because this person prefers face-to-face communication.
10. C. You should perform a rapport building exercise during the kickoff meeting to ensure that the project team and stakeholders can work together to achieve the project goals.

Chapter 10

"Do I Know This Already?" Quiz

1. D. A project audit is the result of verifying compliance with project requirements.
2. B, C, and D. Project team members, the project sponsor, and project stakeholders should have at least read-only access to all documents created during the Planning phase. Some of these people may even need the ability to edit the documents. Project vendors should only be provided with documents that apply to their specific procurement.
3. B. If a team member is added to the project, it is likely to alter the project's schedule because the project manager has another resource that can complete some project tasks.

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4. A. If a procurement will cost more to complete, it is likely to alter the project's budget if approved.
5. D. The project sponsor, project stakeholders, and project team members should be notified if the risk management plan is updated.
6. A. Project milestones should be noted on the project schedule to ensure that proper communication occurs.
7. B. Task initiation/completion is the communication trigger that ensures that a dependent activity starts.
8. A. A gate review is a project event that triggers a meeting between the project sponsor and the project managers to decide whether the project will proceed.
9. C. An incident may result in a business continuity response.
10. D. When a task cannot start until its predecessor task finishes, it is a finish-to-start (FS) relationship.

Review Questions

1. D. You should perform a project audit to determine whether the project is complying with project requirements and quality metrics.
2. B. A procurement change request might require communication with a project vendor.
3. D. A budget change will most likely occur because a new team member has been added, potentially increasing project costs.
4. A. A new project requirement is an example of a stakeholder change.
5. D. The change control board (CCB) must approve this change before it is communicated to the project team.
6. C. A budget change occurs when a procurement contract is for a higher dollar amount than estimated.
7. A and C. Resource and budget changes are the two communication triggers that have occurred as a result of renting a backhoe.
8. A. The project team member(s) responsible for task C2 should most likely be contacted after the completion of task C1, because it has a start-to-finish (SF) relationship with task C2.
9. B. A gate review is a meeting held to determine whether the project will continue.
10. C. Incidents often result in a business continuity response.

Chapter 11

"Do I Know This Already?" Quiz

1. D. The first step in the change control process is to identify and document the change.
2. C. The change control board is most likely to be the approval authority for a change request.
3. B. The purpose of a regression plan is to ensure that the change can be rolled back.
4. A. A schedule change should be initiated if a project task will exceed original estimates.
5. D. A budget change should be initiated if a team member's pay rate increases.
6. C. A risk event has occurred if you had anticipated this problem and made alternative plans.
7. B. A resource change should be initiated if a planned project resource is unavailable.
8. A. A business acquisition occurs when a company purchases a competitor.
9. D. An internal reorganization occurs when a company merges departments.
10. C. A business process change occurs when a formal approval process is revised.

Review Questions

1. B. According to CompTIA's change control process, you should evaluate the impact of the change and provide justification.
2. C. A regression plan allows the project to roll back the change if necessary.
3. D. The change control board reviews all project change requests and approves or denies them.
4. A. The requested change is a schedule change. While this change will also affect the project budget and resources, the actual proposed change is to add a task, which is part of the schedule.
5. D. A budget change is necessary because the lumber will cost more than originally expected.
6. C. A requirements change has occurred because the project sponsor now requires testing in spring and summer.

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7. B. A risk event has occurred. In this scenario, you anticipated this risk and planned for it. A resource change would be necessary if you had not anticipated this risk.
8. A. This is a quality change because a higher grade of steel is needed.
9. B. This business process change will require you to go through a different approval process for half of the procurements for this project.
10. C. This is an internal reorganization. The software development company in answer A is outsourcing. The management in answer B is relocating the business. The company in answer D is experiencing a business demerger or split.

Chapter 12

"Do I Know This Already?" Quiz

1. D. The project scheduling software mainly tracks project activities, their durations, and the personnel assigned to them.
2. C. A histogram depicts the approximate distribution of statistical data.
3. B. A scatter chart is used to find a correlation between two variables.
4. A. The purpose of the project dashboard is to provide the project status.
5. B. A vendor knowledge base provides project team members with answers to questions about third-party products.
6. D. Earned value (EV) is used to show the value a project has earned from the money spent to date.
7. A. SWOT analysis is used to identify risks.
8. B. A RACI matrix is used to determine the roles required to handle each project activity.
9. D. A balanced score card (BSC) analyzes four measures: Financial, Customer, Internal Process, and Learning and Growth.
10. C. A Pareto chart helps the project manager identify the largest single source of problems in a project. This type of chart ranks project defects or sources of problems in order, typically by highest frequency or greatest cost to the business.

Review Questions

1. B. The team member should consult the process diagram for the sales and shipping processes.

2. C. A histogram graphically depicts the distribution of a process data set.
3. D. The document created by the project team member is a fishbone diagram.
4. A. The purpose of a Pareto chart is showing the causes of problems, ranked by occurrence.
5. D. Figure 12-13 shows a run chart.
6. C. You should use wiki pages so that team members can determine the structure of the tool and edit it on demand.
7. B. You should use return on investment (ROI) to determine the total dollar return that the project sponsor will receive for the project.
8. A. The project manager should match the project's objectives to the balanced score card (BSC) to ensure that the project aligns with the organization's goals.
9. B. A SWOT analysis is used during the Planning phase to identify project risks.
10. C. The chart in Figure 12-14 is a RACI matrix.

Chapter 13

"Do I Know This Already?" Quiz

1. D. The project charter is used to create the project management plan.
2. C. The project management plan serves as the guide to the project team to ensure that the project's result meets the project sponsor's requirements.
3. B. The issues log lists risks or issues that occur that are not on the risk register.
4. A. The organizational chart should be used to determine the reporting structure for project team members.
5. B. The scope statement includes project justifications, scope description, acceptance criteria, deliverables, exclusions, constraints, and assumptions.
6. A. The project dashboard is most likely to be accessed for project status information and key performance indicators (KPIs).
7. C. The stakeholder's preference to receive status reports as text messages should be included in the communication plan.
8. D. The project schedule should be analyzed to determine which team members are assigned to a project activity.
9. C. The action items document activities that need to be completed but are not in the project schedule.
10. B. The meeting agenda should be prepared prior to a project meeting.

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Review Questions

1. B. You should consult the project charter to start the planning process and create the project management plan.
2. C. The stakeholder needs the project management plan, which contains the project scope, requirements, schedule, and budget.
3. D. This risk should first be documented in the issues log. If it is indeed a risk, then it should also be added to the risk register for full analysis.
4. A. The organizational chart can help you determine who to negotiate with for this resource.
5. D. The project scope statement includes the scope description for the remodeling project, including whether cabinets will be replaced.
6. C. You would need to analyze the communication plan to determine which stakeholders will receive a particular report.
7. B. You would not find reasons for a delay on the project schedule. See Chapter 11, "Change Control," for details on recording and handling project delays.
8. A. To get caught up on the project, the stakeholder should examine the dashboard and status reports.
9. B. The needed application and research results should be documented in the action items from the meeting.
10. C. The team member should consult the meeting agenda for guidance on what will be discussed at the meeting.

Chapter 14

"Do I Know This Already?" Quiz

1. B. A request for information should be issued if the purchaser is unsure of the specifications of a procurement.
2. A. A request for quote (RFQ) solicits price quotations from prospective sellers of common products or services.
3. C. A request for proposal (RFP) is given to prospective sellers to obtain bids.
4. D. A non-disclosure agreement (NDA) should be used to ensure that vendors and contractors do not share details of the project.
5. B. A memorandum of understanding (MOU) is synonymous with a letter of intent (LOI).

Review Questions

1. B. You should use a request for information (RFI) to obtain details about motorized mechanisms to rotate the stage.
2. C. You should use a request for quote (RFQ) because you know the exact specifications and models for the equipment you need to purchase.
3. D. After receiving and analyzing all the vendors' responses to the request for information (RFI), the next step is to issue a request for proposal (RFP).
4. B. You implemented a fixed price incentive fee (FPIF) contract at a specified price for the procurement and including a bonus for early delivery.
5. D. A time and materials (T&M) contract will be used for this procurement.
6. C. You should use a cease-and-desist letter to inform the other company of the issue and request (or demand) that they stop infringing your patent.
7. B. You should use a non-disclosure agreement to ensure that personnel from the third party do not share information regarding the new mobile app.
8. A. You should use a letter of intent (LOI) to allow the procurement to proceed while the formal contract is completed. LOIs are temporary.
9. B. You should draft a service-level agreement (SLA) to ensure that the necessary performance levels are maintained for project success.
10. C. You should check the warranty to determine whether the equipment is warranted to last for the duration of the project.

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Glossary

AC *See* actual cost (AC).

accept risk *See* risk acceptance.

accepting risk *See* risk acceptance.

accommodating *See* smoothing.

acquired resources Personnel from outside sources, such as consultants and subcontractors.

action items Project concerns that must be addressed. Action items should require few resources and usually less than one week to resolve. These items should not cause delays in the project.

actual cost (AC) The actual money spent to date on a project. AC requires no formula; it is simply the used portion of the project budget.

adaptive planning Project planning that breaks a project into small components created over an undetermined timeline, giving the project flexibility.

adjourning The team-building phase in which the team completes the project.

Agile A methodology for managing teams and projects. The term *Agile* is derived from the Agile manifesto (see agilemanifesto.org).

agreement *See* contract.

archive 1) A location where project documents are stored. 2) An activity completed during the Closing phase of a project. The project manager archives project documentation to ensure that it is maintained until it is no longer needed.

assumption A factor in the Planning phase of a project. An assumption is considered to be true.

attribute A characteristic that varies between resources.

audit A project process to verify that project deliverables comply with the guidelines set forth in the project management plan, in order to validate the performance of the project.

avoid risk *See* risk avoidance.

avoiding A conflict-resolution technique that postpones the issue until the project manager can be better prepared or other parties can resolve the issue. Also known as *withdrawing*.

avoiding risk *See* risk avoidance.

backlog In an Agile project, a document that contains any requirements not currently being addressed.

backward pass A method for calculating a task's late start (LS) and late finish (LF).

balanced score card (BSC) A business document in which management spells out the strategic targets for the organization. The BSC includes four sets of measures: Financial, Customer, Internal Process, and Learning and Growth.

behavioral constraints The behavioral rules for each culture that affect verbal and nonverbal communication. Examples include eye contact, direct discussion versus talking around an issue, and even how close people stand to each other.

benched resource Resource that is available for a project but not being utilized. Usually refers to personnel.

BSC *See* balanced score card (BSC).

budget The approved estimate of expenditures for a project. A project's budget starts with the cost baseline, and it can be changed through the formal change control process.

burn rate The rate at which the project budget is being spent. The burn rate is an inverse of CPI. The formula for computing burn rate is 1 / CPI.

burndown chart The most common sprint-tracking mechanisms used in Agile development. A burndown chart shows the amount of effort expended and remaining for the current sprint.

business acquisition When one business purchases another business.

business case A document created during the Initiating phase of a project. The business case establishes the benefits of the project and acts as a basis for project authorization.

business continuity The capability of a project to continue at acceptable levels following a disruptive incident.

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business demerger When a business splits into separate entities.

business merger When two organizations combine into one entity.

business split *See* business demerger.

cause-and-effect diagram *See* fishbone diagram.

CCB *See* change control board (CCB).

cease-and-desist letter A letter sent to direct a person or entity to stop doing something immediately (cease) and never do it again (desist). This document usually applies to a particular activity, labor practice, or method of competition.

champion *See* sponsor.

change control An activity that occurs during the Monitoring and Controlling phase of a project. Change control involves reviewing, approving, and managing project change requests.

change control board (CCB) The group of individuals who are responsible for reviewing every requested project change and approving or rejecting the request.

change control process A formal procedure for reviewing all change requests, approving changes, managing the changes, and communicating how they will affect the project.

change log A comprehensive list of changes requested during the project.

change management plan A document created during the Planning phase of a project. The change management plan defines how project change requests will be managed and implemented.

change request A formal proposal to modify any project document, deliverable, or baseline.

charter *See* project charter.

Close phase *See* Closing phase.

close-out meeting *See* closure meeting.

Closing phase The last phase of a project. The Closing phase completes all project activities.

closure meeting Also called *close-out meeting*. This meeting is held as soon as possible after actual project completion, in order to ensure that final project information is recorded while the knowledge is still fresh.

cognitive constraints The cultural world views that provide a backdrop to which all new information is compared. Examples include religion, literacy level, gender, and economic status.

collaboration tools Tools for helping a project team work together. Collaboration tools focus on helping increase efficiency and output within the team, rather than communicating with individuals outside the team.

collaborative negotiation A negotiation that seeks a win-win situation and works to build relationships while minimizing conflict.

communication management *See* project communication management.

communication medium The mode of communication.

communication plan A document created during the Planning phase of a project. The communication plan describes how, when, and by whom information about the project will be distributed to the project team and stakeholders.

competing *See* forcing.

competitive negotiation A negotiation that is concerned with getting the best deal. Used mostly in contractual negotiations with third parties.

compromising A conflict-resolution technique in which the team searches for a solution that will bring satisfaction to all parties by partially resolving the conflict. Also known as *reconciling*.

configuration management plan Defines how the configuration of a product, result, service, or component will be documented, tracked, and defined as part of change management.

confronting A conflict-resolution technique in which the team uses multiple viewpoints to lead to consensus. Also known as *problem solving*.

constraint A factor that limits the scope or execution of a project.

constraint reprioritization An event that occurs when a project that is limited by a particular constraint must shift priorities to another constraint.

contingency reserve Funds reserved in the budget to cover known risks.

contract The document that spells out the conditions of the transaction between two parties. *See also* procurement agreement.

corporate environment The type of organization and the organization's culture.

correlation chart *See* scatter chart.

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cost baseline The approved budget on which the project is based. The baseline amount never changes, although the project budget can change based on the formal change control process.

cost control Monitoring project costs and managing changes to the cost baseline.

cost management *See* project cost management.

cost management plan Describes how costs will be planned, structured, and controlled.

cost performance index (CPI) The ratio of earned value to actual cost. The formula for computing CPI is EV / AC.

cost plus award fee (CPAF) contract A contract wherein the vendor receives payment for all allowed costs. The award fee is earned based on performance criteria spelled out in the contract.

cost plus fixed fee (CPFF) contract A contract wherein the vendor receives payment for all allowed costs plus a fixed fee, which is a percentage of the estimated costs. The payment does not change unless the project scope changes.

cost plus incentive fee (CPIF) contract A contract wherein the vendor receives payment for all allowed costs plus an incentive fee based on the objectives spelled out in the contract.

cost report A report created by the project manager, indicating budgeted expenses, actual expenses, and the difference between those two values.

cost variance (CV) The budget deficit or surplus at any given point in time. The formula for computing CV is EV – AC.

CPAF contract *See* cost plus award fee (CPAF) contract.

CPFF contract *See* cost plus fixed fee (CPFF) contract.

CPI *See* cost performance index (CPI).

CPIF contract *See* cost plus incentive fee (CPIF) contract.

critical path The sequence of tasks comprising the project path that takes the longest amount of time to complete.

cultural differences Influences to project communication that occur based on an individual's ways of thinking about, seeing, and hearing the world.

CV *See* cost variance (CV).

dashboard A graphical report that displays important project status information, usually including key performance indicators, project metrics, current progress, and related issues.

dedicated resource A resource allocated to a single project.

deliverable *See* project deliverable.

dependency A task that relies on the completion of a previous task. *See also* predecessor.

directing *See* forcing.

duration How long a task will take to complete.

EAC *See* estimate at completion (EAC).

early finish (EF) The earliest date on which a task can be completed.

early start (ES) The earliest date on which a task can begin.

earned value (EV) The value a project has earned from the money spent to date. The formula for computing EV is (% of completed work) × budget.

earned value management (EVM) A calculation method that combines scope, schedule, and resource measurements to assess project performance.

emotional constraints The cultural rules for displaying emotion. Examples include yelling, crying, deference, and any other exhibition of emotion.

enhance risk *See* risk enhancement.

enhancing risk *See* risk enhancement.

estimate at completion (EAC) A new forecast for the project budget or cost baseline, based on changes that have occurred in the project. Multiple formulas can be used, depending on the project conditions.

estimate to complete (ETC) A forecast that gives the project managers an approximate idea of how much money will be required to complete the remaining balance of the project.

ETC *See* estimate to complete (ETC).

EV *See* earned value (EV).

EVM *See* earned value management (EVM).

Execute phase *See* Executing phase.

Executing phase The third phase of a project. The Executing phase completes the work defined in the project management plan.

Execution phase *See* Executing phase.

exploit risk *See* risk exploitation.

exploiting risk *See* risk exploitation.

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FFP contract *See* firm fixed price (FFP) contract.

finish-to-finish (FF) relationship A project task relationship in which the predecessor activity must finish for the successor activity to finish.

finish-to-start (FS) relationship A project task relationship in which the predecessor activity must finish for the successor activity to start.

firm fixed price (FFP) contract A contract wherein the price for the procurement is set at the outset and cannot change unless the scope of work changes.

fishbone diagram A diagram that categorizes the potential causes of a problem, to help the project team identify root causes.

fixed price incentive fee (FPIF) contract A contract wherein the price for the procurement is set at the outset. However, this contract includes a clause that ties financial incentives for the vendor to certain conditions—usually related to cost, schedule, or technical performance, but with a price ceiling included.

fixed price with economic price adjustment (FP-EPA) contract A contract wherein the price for the procurement can be affected over time, because these contracts can span a period of years. The price can fluctuate based on changing conditions such as inflation or commodity cost changes. Usually the economic adjustment clause is tied to a specific financial index.

float Also called *slack*. The difference between the late start (LS) and early start (ES) values for a task. Tasks with a float of 0 are critical tasks and must be started and completed on time.

flowchart *See* process diagram.

forcing A conflict-resolution technique that pursues one viewpoint despite the existence of other viewpoints on the team. Also known as *directing* or *competing*.

forming The team-building phase in which the team meets and learns about how they will work together on the project.

forward pass A method for calculating a task's early start (ES) and early finish (EF).

FP-EPA contract *See* fixed price with economic price adjustment (FP-EPA) contract.

FPIF contract *See* fixed price incentive fee (FPIF) contract.

functional manager A person who manages project team members in a functional team structure.

functional team structure Team structure in which each employee reports to a single manager or supervisor.

Gantt chart A chart that displays a project's scheduled activities or tasks over time, often including the activity's dependencies and relationships.

gate review The project managers and project sponsor meet to determine whether to continue the project. Gate quality-control checks are also performed at this time. Project sponsors make go/kill decisions based on criteria defined during the Planning phase of each gate.

global environment Conditions outside the project's company: regulatory environment, physical environment (the natural world), political environment, and/or fiscal environment.

governance gate A point in the project schedule when formal approval must be obtained before proceeding.

groupthink A group dynamic in which the group makes decisions in a way that discourages individual creativity or responsibility.

high-level risks A list included as part of the project charter. High-level risks are uncertain events that may have a positive or negative effect on the project objectives. Risks are assessed more fully after the project is authorized.

high-level scope A statement included as part of the project charter. The high-level scope defines the high-level work that must be performed to deliver the project result.

histogram A specialized type of bar graph that represents continuous data for a specific range. Graphically depicts the approximate distribution of statistical data.

human resource management *See* project human resource management.

human resource management plan Describes how human resources will be structured and managed, including their roles, responsibilities, and reporting relationships.

incident An event in a project that could lead to a disruption in the project.

incident management The process of limiting how much an event can disrupt a project.

incremental process A process that produces usable deliverables as each step is completed.

influence A project event or condition that can affect a project constraint.

Initiate phase *See* Initiating phase.

Initiating phase The first phase of a project. The Initiating phase defines a new project and obtains authorization to start that project.

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Initiation phase *See* Initiating phase.

instant messaging Using computer or mobile applications managed by a provider, such as Google or Microsoft.

intangible outcome A nonphysical asset, such as a patent, trademark, franchise, good will, or copyright.

integration management *See* project integration management.

Internet site A website that is hosted publicly.

interorganizational differences Differences between organizations.

interproject dependency When one project must wait for another project to complete results that are needed by the first project.

intranet site A website that is accessible exclusively within an organization.

intraorganizational differences Differences within an organization.

Ishikawa diagram *See* fishbone diagram.

issues Problems, gaps, inconsistencies, or conflicts that occur unexpectedly in the life cycle of a project and were not previously identified as risks. Issues usually require multiple resources and considerable time to resolve.

issues log A document recording all issues raised by stakeholders.

iterative process A process that makes progress toward the desired result through sequential refinement.

key performance indicator (KPI) A measure that evaluates the success of a project or a project deliverable in meeting objectives for performance. Synonymous with *key performance parameter (KPP)*, the term used by the U.S. Department of Defense (DoD).

key performance parameter (KPP) *See* key performance indicator (KPI).

kickoff meeting The first meeting of the project team and project sponsor. This introductory meeting clarifies all the team members' parts in the project.

knowledge area *See* project knowledge area.

knowledge base *See* vendor knowledge base.

KPI *See* key performance indicator (KPI).

language barriers Influences to project communication that occur when team members or stakeholders speak different languages.

late finish (LF) The latest date on which a task can be completed.

late start (LS) The latest date on which a task can begin.

lessons learned 1) A database or other storage location where lessons learned from all projects are stored. 2) An activity completed during the Closing phase of a project. In the "lessons learned" document, the project manager records any knowledge gained during a project and shows how project issues and events were addressed.

letter of intent (LOI) A document that outlines the plans of an agreement between two or more parties, usually a precursor to a formal contract. In the United States, *letter of intent* is generally considered synonymous with *memorandum of understanding (MOU)*.

LOI *See* letter of intent (LOI).

lose-lose A conflict-resolution solution that does not satisfy either party.

management reserve A portion of the project budget that is held for management control purposes, mainly used when unforeseen work is necessary to complete the project's scope.

material resources Any supplies that a project may need.

matrix team structure Team structure in which authority is shared between functional managers and project managers, resources are assigned from functional areas to projects, and project manager authority ranges from weak to strong.

meeting agenda A document that provides the topics of discussion for a meeting.

meeting minutes A record of all that is discussed and any decisions that are made during the meeting.

memorandum of understanding (MOU) Another term for *letter of intent (LOI)*.

merger *See* business merger.

milestone A significant event in a project. Milestones are incorporated into the project schedule, but they do not have durations because they are not actually project tasks. Rather, milestones are points in time that are reached as a project progresses.

milestone list A document that identifies all project milestones and indicates whether each milestone is mandatory.

mitigate risk *See* risk mitigation.

mitigating risk *See* risk mitigation.

Monitor and Control phase *See* Monitoring and Controlling phase.

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Monitoring and Controlling phase The fourth phase of a project. The Monitoring and Controlling phase tracks, reviews, and organizes the project's progress.

MOU *See* memorandum of understanding (MOU).

mutually binding document An agreement between two parties in which one party promises to do something for the other in return for payment.

NDA *See* non-disclosure agreement (NDA).

negative risk Undesirable event that may derail the project and should be prevented.

negotiated resources Personnel the project manager wants on the project team and must negotiate with other managers to obtain.

negotiating A conflict-resolution technique that brings two viewpoints together to discuss issues and reach a solution.

noise Any interference or barrier that affects message delivery.

non-compete agreement *See* non-compete clause.

non-compete clause Prevents the vendor from pursuing a similar project with the buyer's direct competitors within a specified time period.

non-disclosure agreement (NDA) A type of confidentiality agreement in which the selected vendor and any vendor personnel involved in the procurement agree not to disclose details about the project.

norming The team-building phase in which the team starts working together, with team members adjusting their work to support the team.

OPCs *See* other project costs (OPCs).

opportunity *See* positive risk.

organizational chart A chart drawn in pyramid form, showing where personnel fit into the project structure.

other project costs (OPCs) All other costs related to a project that are not included in the TEC.

outlier A data point that falls outside the pattern of the majority of points in a chart.

outsourcing When business processes are contracted to entities outside the organization.

Pareto chart A vertical bar chart combined with a line graph to show importance or other values graphed from highest to lowest.

path Also called *pathway*. A sequence of tasks to be completed.

performance measuring and reporting An activity that occurs during the Monitoring and Controlling phase of a project. Project performance is compared to the baselines defined in the project management plan.

performing The team-building phase in which the team starts working as a unit, with team members depending on each other and working through issues easily.

personnel resources The project team members who work to complete the project.

phase *See* project phase.

phase-gate model An initiative or project is divided into stages or phases, separated by gates. Each gate completes that phase of the project life cycle and then undergoes review before the project moves on to the next phase. Also known as *phase-gate process* or *stage-gate process*.

Plan phase *See* Planning phase.

planned value (PV) The planned cost for the amount of work that is currently completed. The formula for computing PV is (planned % complete) × budget.

Planning phase The second phase of a project. The Planning phase establishes the total project scope and objectives and develops the actions required to achieve the objectives.

PMO *See* project management office (PMO).

PO *See* purchase order (PO).

portfolio All of the projects, programs, and operations managed by an organization to allow it to reach strategic objectives.

positive risk A risk that is considered an opportunity. A desirable event that the project wants to occur.

preassigned resources Personnel assigned to the project from the start, based on position in the organization and/or knowledge and skill set.

predecessor A task that must be completed prior to starting the next task. *See also* dependency.

predecessor activity An activity that comes before any dependent activities.

predictive planning Project planning that uses historical data to provide a linear development plan structured around the desired result.

problem solving *See* confronting.

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process diagram A sequential breakdown of the steps required to complete a business process, displayed in relation to each other.

process improvement plan Details the steps for analyzing processes to identify activities that enhance their value.

procurement agreement Any document that defines the purchase terms of particular goods or services that must be acquired from a third party.

procurement management *See* project procurement management.

procurement management plan Also called *procurement plan*. A document created during the Planning phase of a project. Describes how goods and services will be procured from outside sources.

procurement plan *See* procurement management plan.

product owner An Agile product's key stakeholder, who provides the overall vision for the product.

program A grouping of related projects or activities that are managed in coordination to obtain benefits not available if they were managed individually.

project A temporary endeavor undertaken to create a unique product, service, or result.

project budget A document that provides an estimate of costs for the project. The project budget includes a breakdown of costs for individual WBS work packages, procurements, and scheduled activity.

project charter A document created during the Initiating phase of a project. The project charter authorizes the project and allows the project manager to apply organizational resources to complete the project.

project communication management The project knowledge area that ensures that project information is properly created, distributed, and stored.

project coordinator The role that supports the project manager to coordinate activities, resources, equipment, and information. Focuses mainly on project implementation and cross-functional coordination of all project tasks.

project cost control *See* cost control.

project cost management The project knowledge area that ensures that project costs are within the approved budget.

project dashboard A tool that gives stakeholders and team members a quick look at the overall project. The dashboard includes the project's status reports and may include other components such as key performance indicators, project metrics, project progress, and details of other project issues.

project deliverable The main output(s) of the project created during the Executing phase, consisting of the unique work packages defined in the WBS.

project environment Conditions within the project, including any variables that must be present to complete the project.

project human resource management The project knowledge area that ensures that the project team is organized and managed to complete the project.

project integration management The project knowledge area that identifies and coordinates all the processes and activities in a project.

project knowledge area A division of project management in which processes are grouped into particular specialization activities such as integration, scope, time, cost, and so on.

project management office (PMO) Provides project management governance and ensures that resources, methods, tools, and techniques are shared or coordinated across all projects.

project management plan The overall document created in the Planning phase of a project. The project management plan includes management plans for all the project knowledge areas.

project manager The individual who is selected to manage the project, lead the project team, and ensure the project's success.

project phase A distinct period in project management in which certain types of activities are completed: Initiating, Planning, Executing, Monitoring and Controlling, and Closing.

project procurement management The project knowledge area that ensures that any products or services needed from a third party are acquired.

project quality management The project knowledge area that ensures that the project quality satisfies the needs of the project.

project requirements A listing of any stakeholder needs and requirements for the project. Some stakeholder requirements may not be included in the final approved list for the project.

project reserve Provision in the budget to mitigate cost and/or schedule risks. Management reserves and contingency reserves are two types of project reserves.

project risk management The project knowledge area that ensures that project risks are identified, analyzed, and controlled.

project schedule A document that presents project activities with their planned start/end dates, durations, milestones, and resources.

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project scheduling software Programs and apps that support "what if" scenarios, track project efficiency, and analyze schedules by using charts and diagrams.

project scope The work performed to provide the total products, services, or results from a project.

project scope management The project knowledge area that ensures that the required work is complete and within the defined project scope.

project scope statement A formal statement that includes project justifications, scope description, acceptance criteria, deliverables, exclusions, constraints, and assumptions.

project sign-off A document completed during the Closing phase of a project. The project sign-off provides a formal method for validating project completion according to the project management plan.

project sponsor The individual or organization that must formally authorize the project, based on the project charter.

project stakeholder An individual, group, or organization that may affect or be affected by any part of the project.

project stakeholder management The project knowledge area that documents the expectations and project impact of any people, groups, or organizations that will be affected by the project.

project statement of work A description of the products, services, or results to be delivered by a project. The project statement of work is used during the Initiating phase of the project.

project team The group of individuals who work with the project manager to perform project tasks to ensure the project's completion.

project time management The project knowledge area that ensures that the project is completed on time.

projectized team structure Team structure in which the project manager has full authority, personnel report to the project manager, and resources are allocated to projects on an *ad hoc* basis.

purchase order (PO) A document that is issued immediately after a contract is signed, clarifying the details of the purchase. The PO states the financial agreement, terms, method of delivery, delivery date, quantity needed, and so on, and is binding for the purchaser.

PV *See* planned value (PV).

qualitative risk analysis Performing risk probability and impact assessments to develop a probability and impact matrix, which provides a risk score to guide risk responses.

quality assurance An activity that occurs during the Monitoring and Controlling phase of a project. Quality metrics and checklists are used with tools such as fishbone diagrams, flowcharts, and so on to solve project quality problems.

quality gate A point in the project schedule when acceptance criteria are analyzed to ensure that completed deliverables meet the quality control guidelines established during project planning.

quality management *See* project quality management.

quality management plan Describes how the project's quality policies will be implemented.

quantitative risk analysis Assigning numerical values to identified risks.

RACI matrix *See* responsible, accountable, consulted, and informed (RACI) matrix.

rapport Getting along with another person or group, based on finding common ground.

reconciling *See* compromising.

regression plan The process whereby an approved change can be reversed.

request for information (RFI) A procurement document in which the buyer requests that a potential seller provide information related to the product/service or to the seller's capability to provide the product/service.

request for proposal (RFP) A procurement document in which the buyer requests proposals from prospective sellers of products or services.

request for quote (RFQ) A procurement document in which the buyer requests price quotations from prospective sellers of common products or services, such as computers or building materials.

requirements *See* project requirements.

requirements management plan A document created during the Planning phase of a project. The requirements management plan describes how the project requirements will be analyzed, documented, and managed.

reserve analysis A method of determining funds that are held to account for any cost uncertainty that the project may encounter.

reserves Project monies that are allocated to deal with unanticipated risks.

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resource allocation The process of assigning resources to individual project activities or tasks.

resource breakdown structure A document that breaks down allocated resources hierarchically by category and type.

resource calendar A document that lists all resources and the dates and times when they are available to the project.

resource contention When multiple projects need a particular resource at the same time.

resource leveling A resource optimization technique that adjusts a task's start and finish dates based on resource constraints. This technique might increase the original critical path.

resource management The process of ensuring that all the supplies needed to complete a project are identified and managed appropriately.

resource overallocation When a project has too much of a particular resource, resulting in leftover inventory or idle team members.

resource release The activity whereby all resources are released during the Closing phase of a project.

resource shortage When a project does not have enough of a particular resource to complete an activity or task.

resource smoothing A resource optimization technique that adjusts the float amounts of a task's activities. This technique prevents resource requirements from exceeding the limits of available resources.

resources The personnel and other assets needed to complete the project, including personnel, equipment, services, supplies, and funds.

responsible, accountable, consulted, and informed (RACI) matrix A project tool used during the Planning phase of a project to analyze the project stakeholder and team member roles and responsibilities in relation to project activities or tasks.

RFI *See* request for information (RFI).

RFP *See* request for proposal (RFP).

RFQ *See* request for quote (RFQ).

risk Any uncertain event that may have a positive or negative effect on the project's objectives or other aspects of the project, such as the project cost, scope, or schedule.

risk acceptance A risk strategy for both negative and positive risks. The project team acknowledges the risk but decides not to take any action.

risk activities Planning risk management, identifying risks, performing risk analysis, planning risk responses, and controlling risks. These risk activities occur during the Planning phase and the Monitoring and Controlling phase of a project.

risk appetite The amount of uncertainty the organization is willing to take on in hope of a reward.

risk avoidance A risk strategy for negative risks whereby the project team eliminates the risk or protects the project from the risk.

risk cause Conditions or events that led up to the risk.

risk communication Risk reporting that is documented as part of the risk management plan. It defines how to document, analyze, and communicate with project team members and stakeholders about risks.

risk enhancement A risk strategy for positive risks whereby the project team identifies the key drivers that affect a risk and adjusts them to increase the probability of the risk.

risk exploitation A risk strategy for positive risks whereby the project team ensures that the risk occurs.

risk identification The process of determining in advance what risks may affect a project and documenting them in the risk management plan.

risk impact The effects that the risk will have on the project.

risk management *See* project risk management.

risk management plan A document that describes all the known risks that may affect a project and the strategies that will be used to handle each risk. Part of the project management plan.

risk mitigation A risk strategy for negative risks whereby the project team reduces the probability that the risk will occur or lessens the projected impact of the risk.

risk planning The project management process that formally creates the risk management plan by ensuring that risks are identified, analyzed, quantified, prioritized, and reviewed, and appropriate responses to each risk are prepared.

risk prioritization Ensuring that risk plans are developed for every identified risk based on its priority.

risk quantification Performing qualitative and quantitative risk analysis to determine the effects of risks on the project objectives.

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risk register The document that charts all risks identified during risk planning.

risk response planning Developing actions to enhance opportunities and reduce threats to the project.

risk review Periodically investigating risks during the project's Monitoring and Controlling phase to detect any new risks that may have arisen and ensure that planned risk strategies are still effective.

risk sharing A risk strategy for positive risks whereby partial ownership of the risk is allocated to a third party.

risk tolerance The amount of risk that an organization can withstand.

risk transference A risk strategy for negative risks whereby the risk impact is shifted to another party.

risk trigger An event or condition that will cause a contingency plan to be implemented.

roles The job duties that are part of a project.

roll wave planning An activities definition process in which closer activities are planned in detail and activities in the future are planned at a high level. As the project progresses and requirements become clearer, more detailed planning is done for the work packages at lower levels of the WBS.

run chart A chart that shows trends, variations, or declines/improvements in a project over time, using a line graph.

scatter chart A chart that is used to find the correlation between two variables.

scatter diagram *See* scatter chart.

scatter plot *See* scatter chart.

schedule *See* project schedule.

schedule baseline The approved version of the project schedule.

schedule management plan Establishes the activities for developing, monitoring, and controlling the schedule.

scheduler The role that develops and maintains the project schedule and works to ensure that resources are available when needed. The tasks for this role may be fulfilled by the project manager.

scope *See* project scope *or* high-level scope.

scope baseline The project document used as the basis for comparing scope control during the Executing phase and the Monitoring and Controlling phase of a project. The scope baseline includes the project scope statement, work breakdown structure (WBS), and WBS dictionary.

scope creep A condition in a project that occurs when the project scope is changed without adjusting other project constraints, including cost, time, and resources.

scope management *See* project scope management.

scope management plan A document created during the Planning phase. The scope management plan describes how the scope is defined, developed, monitored, controlled, and verified. It is one of the main components of the project management plan.

scope statement The project document that provides the project scope description, major deliverables, assumptions, and constraints.

scrum A project management framework that emphasizes teamwork, accountability and iterative progress toward a well-defined goal.

scrum master The facilitator for a product development team that uses scrum or Agile.

scrum retrospective A meeting held at the end of every sprint to discuss the sprint and note any changes that could help make the next sprint more productive.

service-level agreement (SLA) A contract between a service provider and its customer. The SLA sets specific metrics for different aspects of the service, including quality, availability, and responsibilities.

share risk *See* risk sharing.

shared resource A resource used jointly between multiple projects.

sharing risk *See* risk sharing.

SLA *See* service-level agreement (SLA).

slack *See* float.

smoothing A conflict-resolution technique that emphasizes areas of agreement rather than differences. Also known as *accommodating*.

SOW *See* statement of work (SOW).

sponsor The individual or organization that authorizes the project.

sprint A repeated, iterative work cycle in an Agile project. The goal of a sprint is to complete one of the product's requirements in a usable form.

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sprint planning The process that decides the specific work to be handled in the upcoming sprint.

stakeholder Any individual, group, or organization with a vested interest in the success of a project.

stakeholder management plan A document created during the Planning phase of a project. The stakeholder management plan specifies how to manage and engage the project stakeholders, including each stakeholder's engagement level, relationships, and communication requirements. Defines the tools and techniques to engage stakeholders in project decisions and execution, based on each stakeholder's needs, interests, and impact on the project.

stakeholder register A list created during the Initiating phase of a project. The stakeholder register lists all stakeholders, along with their identification information, requirements and expectations, influence on the project, and classification.

start-to-finish (SF) relationship A project task relationship in which the predecessor activity must start for the successor activity to finish.

start-to-start (SS) relationship A project task relationship in which the predecessor activity must start for the successor activity to start.

statement of work (SOW) A document that gives a description of the procurement item so that prospective sellers know the specifications and can determine whether they can provide the procurement to meet the specifications.

status report A document that provides the latest information on project activities, issues, changes, and risks.

storming The team-building phase in which the team starts making decisions about the project.

story mapping A technique for discovering requirements in an Agile project. The team maps out user stories to discover the features that the customer needs.

strengths, weaknesses, opportunities, and threats (SWOT) analysis A project tool used during the Planning phase of a project to identify project risks that may cause problems or present opportunities.

successor activity An activity that comes after the activity on which it is dependent.

SWOT analysis *See* strengths, weaknesses, opportunities, and threats (SWOT) analysis.

T&M contract *See* time and materials (T&M) contract.

tangible outcome A physical asset that can be measured, such as land, vehicles, equipment, machinery, furniture, inventory, or cash.

task list A document listing all the tasks needed to complete a project. Each task must have a unique name and should be tracked back to a WBS component.

TCPI *See* To-Complete Performance Index (TCPI).

TEC *See* total estimated costs (TEC).

text messaging Textual "conversations" conducted on mobile devices via the cell phone provider's communication bandwidth.

threat *See* negative risk.

time and materials (T&M) contract A contract used when a statement of work is not possible. The full value of the contract and quantity of items needed may not be defined, so the contract is considered open-ended. Payment is given based on billable time and all allowed costs. These contracts often include not-to-exceed values, time limits, and unit labor or material rates.

time management *See* project time management.

To-Complete Performance Index (TCPI) The cost performance that is required with the remaining resources. There are two main formulas for calculating TCPI:

1) TCPI using current budget = (budget – EV) / (budget – AC)

2) TCPI using EAC value = (budget – EV) / (EAC – AC)

total estimated costs (TEC) All the estimated costs in the initial project budget.

total project cost All costs specific to a project incurred from project initiation through project closure.

transfer risk *See* risk transference.

transition/integration plan A plan created during the Closing phase of a project. The transition/integration plan includes details on how the project team will be transitioned to or integrated into other projects or areas within the organization.

trend line In a scatter chart, the line along which most of the points lie.

triple constraint The main limits on a project: scope, time, and cost.

user stories The basis for defining the requirements for an Agile project. Each user story indicates who wants the product, what the team is building, and why the team is building it.

vendor knowledge base A database that contains authorized information about a particular vendor's products.

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virtual meeting A meeting conducted using technology, such as video conferencing, that allows personnel from different geographical areas to attend.

virtual team A project team in which all or part of the team works remotely.

warranty A document from the vendor that provides an assurance of the level of quality for a procurement.

WBS *See* work breakdown structure (WBS).

WBS dictionary A companion document to the work breakdown structure (WBS). The WBS dictionary provides detailed information about each WBS component, including the identifier, deliverable, description, and scheduling information.

wiki A type of website that is used to manage collaborative content. The wiki users determine the structure of the site and are able to edit the content. Wiki pages typically need little technology expertise.

win-win A solution that satisfies the concerns of both parties.

withdrawing *See* avoiding.

work breakdown structure (WBS) A hierarchical listing of the activities or work packages that must be completed during the project. This project document subdivides the project's work into manageable components.

work package The smallest unit of work in the WBS.



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Memory Tables

Fill in the empty spaces to complete each table. Check your answers against the finished versions of the tables in Appendix C, "Memory Tables Answer Key."

Table B-1: What Is a Project?

In Table B-1, select the correct column for each activity, indicating whether the activity describes a **project** or a **day-to-day operation**. See Chapter 1, "Project Properties and Phases," if you need a refresher.

Table B-1 Projects Versus Day-to-Day Operations

Activity	Project	Day-to-Day Operation
Performing regular landscape services		
Upgrading a fleet of automobiles to include video recorders		
Designing a training program for teachers' aides		
Launching a new web server		
Changing the window displays at a car dealership		
Performing routine oil changes on a fleet of automobiles		
Developing processes for backing up a file server		
Documenting the help desk process		
Writing the user manual for a new mobile application		
Designing and implementing a landscape design		
Training teachers' aides on new school system policies		
Maintaining a facility		
Adding new inventory to a current jewelry line		
Upgrading a web server's operating system		

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Activity	Project	Day-to-Day Operation
Developing the process for restoring a desktop computer		
Restoring a desktop computer according to documented procedures		
Performing daily tasks at the help desk		
Launching a new jewelry line in a retail chain		
Sending user manual files to customers		
Remodeling the show floor for a car dealership		
Constructing a new facility		
Backing up a file server according to established processes and procedures		

Table B-2: Project Phases

In Table B-2, name the **five project phases** in the order in which they occur. Go back to Chapter 1 if you do not know the phases and their order by heart.

Table B-2 Phases of a Project

Phase Order	Phase Name
1	
2	
3	
4	
5	

Table B-3: Documents and Activities by Project Phase

In Table B-3, name the **project phase** in which each **document or activity** is initiated or conducted. Project documents and activities are discussed throughout the book, but Chapter 1 and Chapter 13 (“Project Documentation”) clarify what happens when.

Table B-3 Documents and Activities by Project Phase

Document/Activity	Phase
Creating stakeholder register	
Creating scope baseline	
Creating stakeholder management plan	
Creating work packages	
Determining quality assurance/governance	
Creating risk management plan	
Creating detailed risks	
Closing contracts	
Creating process improvement plan	
Creating approved schedule	
Creating procurement management plan	
Auditing project deliverables	
Creating requirements management plan	
Creating change log	
Creating configuration management plan	
Creating human resource management plan	
Acquiring resources	
Creating cost management plan	
Creating business case	
Creating resource calendar	
Creating issues log	
Creating change management plan	
Creating schedule management plan	
Creating “lessons learned” document	
Creating scope statement	
Creating quality management plan	
Creating requirements management plan	
Creating communication plan	
Archiving project documents	
Creating list of high-level risks	

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Document/Activity	Phase
Using change control process	
Documenting change control process	
Creating scope management plan	
Creating work breakdown structure	
Determining resource needs	
Releasing resources	
Creating high-level scope definition	
Signing off on completed project	
Creating risk register	
Providing transition/integration plan and training	
Documenting all requirements	
Holding kickoff meeting	
Documenting expected work packages	
Creating project charter	
Measuring and reporting performance	
Creating approved budget	

Table B-4: Earned Value Management (EVM) Value Calculations

In Table B-4, provide the **formula** for calculating each **earned value management (EVM)** value. See Chapter 3, "Project Cost Control," if these formulas are not firmly fixed in your memory.

Table B-4 Earned Value Management (EVM) Value Calculations

EVM	Formula
Planned value (PV)	
Earned value (EV)	
Schedule variance (SV)	
Cost variance (CV)	
Schedule performance index (SPI)	

EVM	Formula
Cost performance index (CPI)	
Burn rate	

Table B-5: Estimate at Completion (EAC) Value Calculations

In Table B-5, provide the **formula** for calculating each **estimate at completion (EAC)** value. If you need help with these formulas, return to Chapter 3.

Table B-5 Estimate at Completion (EAC) Value Calculations

EAC	Formula
EAC using calculated ETC	
EAC for work performed at current rate	
EAC for work performed at current CPI	
EAC for work including both CPI and SPI	

Table B-6: Key Performance Indicators/Key Performance Parameters

In Table B-6, name the **key performance indicator (KPI)** or **key performance parameter (KPP)** that fits each description. Chapter 12, "Project Management Tools," discusses the KPIs and KPPs in detail.

Table B-6 Key Performance Indicators/Key Performance Parameters

Description	KPI or KPP
The planned cost for work that is currently completed	
The actual money spent to date on a project	
The value a project has earned from the money spent to date	
The budget deficit or surplus at any given point in time	
The ratio of earned value to actual cost	
The ratio of earned value to planned value	

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Description	KPI or KPP
The difference between the earned value and the planned value	
The total dollar/time return the project sponsor will receive for the project	
An overview of time and resources spent on supervising and managing the project	
The number of project activities that are overdue	
Indicates whether a project is running ahead of schedule, on time, or behind schedule	
Indicates how far along the tasks are toward completion	
Measures how much time team members are spending on billable activities compared to the time spent on non-billable tasks, such as meetings	
Helps demonstrate the overall project success for an organization	
Shows how sustainable an organization's projects are	



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Memory Tables Answer Key

Table B-1: What Is a Project?

Table B-1 Projects Versus Day-to-Day Operations

Activity	Project	Day-to-Day Operation
Performing regular landscape services		X
Upgrading a fleet of automobiles to include video recorders	X	
Designing a training program for teachers' aides	X	
Launching a new web server	X	
Changing the window displays at a car dealership		X
Performing routine oil changes on a fleet of automobiles		X
Developing processes for backing up a file server	X	
Documenting the help desk process	X	
Writing the user manual for a new mobile application	X	
Designing and implementing a landscape design	X	
Training teachers' aides on new school system policies		X
Maintaining a facility		X
Adding new inventory to a current jewelry line		X
Upgrading a web server's operating system		X
Developing the process for restoring a desktop computer	X	
Restoring a desktop computer according to documented procedures		X
Performing daily tasks at the help desk		X
Launching a new jewelry line in a retail chain	X	
Sending user manual files to customers		X
Remodeling the show floor for a car dealership	X	
Constructing a new facility	X	
Backing up a file server according to established processes and procedures		X

Table B-2: Project Phases

Table B-2 Phases of a Project

Phase Order	Phase Name
1	Initiating
2	Planning
3	Executing
4	Monitoring and Controlling
5	Closing

Table B-3: Documents and Activities by Project Phase

Table B-3 Documents and Activities by Project Phase

Document/Activity	Phase
Creating stakeholder register	Initiating
Creating scope baseline	Planning
Creating stakeholder management plan	Planning
Creating work packages	Executing
Determining quality assurance/governance	Monitoring and Controlling
Creating risk management plan	Planning
Creating detailed risks	Planning
Closing contracts	Closing
Creating process improvement plan	Planning
Creating approved schedule	Planning
Creating procurement management plan	Planning
Auditing project deliverables	Monitoring and Controlling
Creating requirements management plan	Planning
Creating change log	Monitoring and Controlling
Creating configuration management plan	Planning
Creating human resource management plan	Planning
Acquiring resources	Executing

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Document/Activity	Phase
Creating cost management plan	Planning
Creating business case	Initiating
Creating resource calendar	Planning
Creating issues log	Monitoring and Controlling
Creating change management plan	Planning
Creating schedule management plan	Planning
Creating "lessons learned" document	Closing
Creating scope statement	Planning
Creating quality management plan	Planning
Creating requirements management plan	Planning
Creating communication plan	Planning
Archiving project documents	Closing
Creating list of high-level risks	Initiating
Using change control process	Monitoring and Controlling
Documenting change control process	Planning
Creating scope management plan	Planning
Creating work breakdown structure	Planning
Determining resource needs	Planning
Releasing resources	Closing
Creating high-level scope definition	Initiating
Signing off on completed project	Closing
Creating risk register	Planning
Providing transition/integration plan and training	Closing
Documenting all requirements	Planning
Holding kickoff meeting	Executing
Documenting expected work packages	Planning
Creating project charter	Initiating
Measuring and reporting performance	Monitoring and Controlling
Creating approved budget	Planning

Table B-4: Earned Value Management (EVM) Value Calculations

Table B-4 Earned Value Management (EVM) Value Calculations

EVM	Formula
Planned value (PV)	(planned % complete) × budget
Earned value (EV)	(% of completed work) × budget
Schedule variance (SV)	EV – PV
Cost variance (CV)	EV – AC
Schedule performance index (SPI)	EV / PV
Cost performance index (CPI)	EV / AC
Burn rate	1 / CPI

Table B-5: Estimate at Completion (EAC) Value Calculations

Table B-5 Estimate at Completion (EAC) Value Calculations

EAC	Formula
EAC using calculated ETC	AC + ETC
EAC for work performed at current rate	AC + (budget – EV)
EAC for work performed at current CPI	budget / CPI
EAC for work including both CPI and SPI	AC + [(budget – EV) / (CPI × SPI)]

Table B-6: Key Performance Indicators / Key Performance Parameters

Table B-6 Key Performance Indicators / Key Performance Parameters

Description	KPI or KPP
The planned cost for work that is currently completed	planned value (PV)
The actual money spent to date on a project	actual cost (AC)

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Description	KPI or KPP
The value a project has earned from the money spent to date	earned value (EV)
The budget deficit or surplus at any given point in time	cost variance (CV)
The ratio of earned value to actual cost	cost performance index (CPI)
The ratio of earned value to planned value	schedule performance index (SPI)
The difference between the earned value and the planned value	schedule variance (SV)
The total dollar/time return the project sponsor will receive for the project	return on investment (ROI)
An overview of time and resources spent on supervising and managing the project	cost of managing processes
The number of project activities that are overdue	overdue project tasks (also called *crossed deadlines*)
Indicates whether a project is running ahead of schedule, on time, or behind schedule	missed milestones
Indicates how far along the tasks are toward completion	percentage of tasks completed
Measures how much time team members are spending on billable activities compared to the time spent on non-billable tasks, such as meetings	resource utilization
Helps demonstrate the overall project success for an organization	percentage of projects completed on time
Shows how sustainable an organization's projects are	percentage of canceled projects

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